THE
BRITISH JOURNAL OF SURGERY

VOL. XXI. JANUARY, 1934. No. 83.

In Memoriam.

SIR GEORGE MAKINS, G.C.M.G., C.B., LL.D.

MAKINS died on Thursday, Nov. 2, a few hours short of his eightieth birthday.

He was educated at King's School, Gloucester, and entered St. Thomas's Hospital Medical School in 1871. After qualification he studied at Vienna and Halle and worked with Roy at the Brown Institute. He was elected to the staff of St. Thomas's in 1887. He helped Sir William MacCormac in the organization of the International Medical Congress in 1881 and was joint treasurer with Sir Dyce Duckworth of that held in 1913.

He was Consulting Surgeon in the Boer War, and embodied his experiences in a book which was translated into several languages. In the Great War he was again a Consulting Surgeon. In 1917 he came home to be President of the Royal College of Surgeons—a position that he filled with great distinction. In the same year he went to India to report on the British Station Hospitals.

He was an active member of the British Red Cross and of the Nightingale Fund, Treasurer of the Imperial Cancer Research Fund, Chairman of the Distribution Committee of the Hospital Sunday Fund, and Chairman of the Executive Committee of the Athenæum.

These bare details of his life show the diversity of his interests and the widespread nature of his influence. Makins by his work earned for himself a fine position in surgery; but he had a greater success than this in that he won the regard and esteem of those around him no matter whether they were old or young. His appearance was striking and dignified; his smile was wonderfully attractive. He had a great store of wisdom, often expressed in unusual terms which were very apposite. This wisdom concerned not only surgery but the everyday things of life. If you went to consult him in an anxious and perturbed state of mind, you soon found things resolving themselves to their just proportions and your course of action seemed obvious, if not agreeable. To be with him gave a sense of peace and security. He was often late, never in a hurry, and yet accomplished with ease all he had set out to do.

As a surgeon he was sure, imperturbable, and constructive; friends, nurses, and doctors owe him much. The confidence in his judgement can

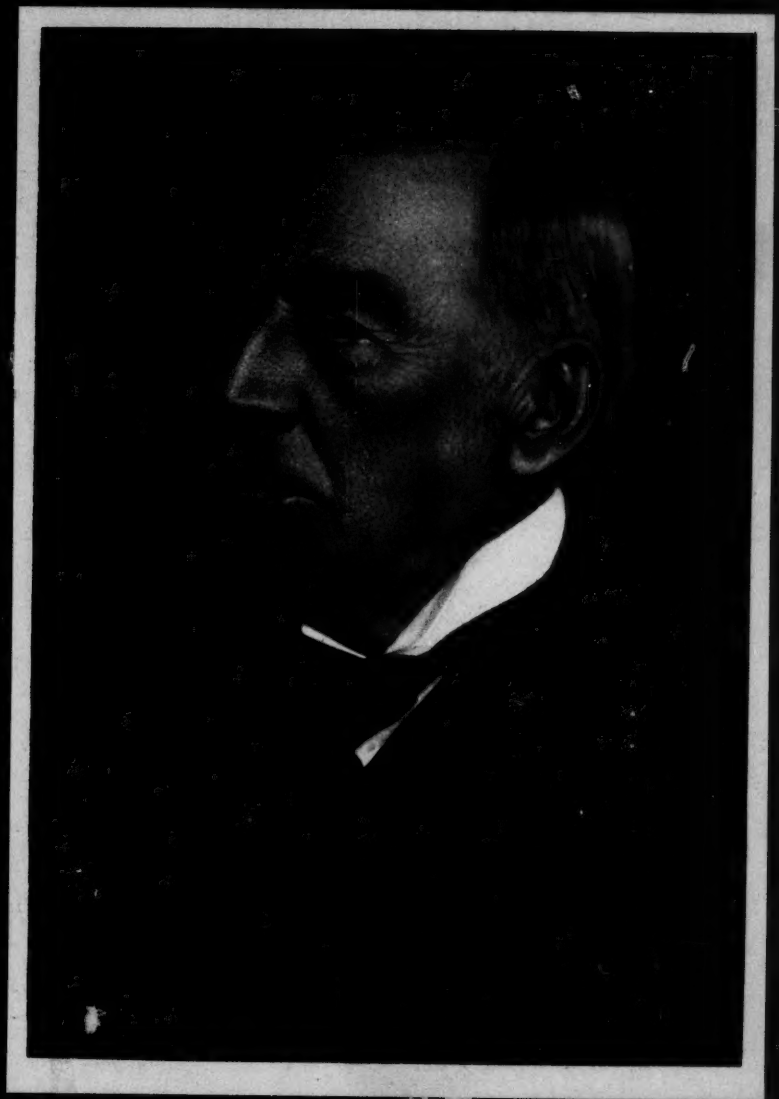
be told by the number of committees on which he served and where his counsel was sought and valued.

Quite unselfish, quiet in argument, which he disliked, he could be very firm but was always fair. In matters affecting himself he was much less tenacious, and on occasion gave way to another, though from the amusing and tolerant way in which he described the retirement one felt that he had not altogether had the worst of the encounter.

In his youth he was rather apart and showed but little aptitude for games. At an early age he took to fishing and gardening. Later on he became a climber, sharing the dangers and delights with Lady Makins. He was a lover of music and played the 'cello, but flowers were his chief hobby, and it was delightful to wander round and hear him talk about them. He was fond of company and a charming host, and many will look back with genuine pleasure to the hospitality of Lady Makins and himself.

Conversation was no trouble to him. He had met many fo'k and few great men in the medical world were unknown to him; many ıd stayed at his house. He had retained kindly memories of these people w ch he was wont to recall in his quiet and distinctive voice. He was a man around whom stories gather, and the tradition of Makins will long remain at his hospital.

To the very end he remained the same, a humorous, placid, kind, and fearless man. A fine life and bravely ended.



PRESENTATION TO THE EDITORIAL SECRETARY.

At a Meeting of the Editorial Committee held on Oct. 12, 1933, reference was made to the completion of the 20th volume of the Journal, and the occasion was marked by a presentation to Mr. Hey Groves, who has filled the office of Editorial Secretary since the founding of the Journal.

Lord Moynihan, in making the presentation, said :—

"Mr. Hey Groves :

"This presentation is made to you on behalf of a number of subscribers to the British Journal of Surgery in recognition of your invaluable services during twenty years as Editorial Secretary. We offer you this salver and cheque as a tribute to your efficiency and devotion. You were one of those in whose mind was conceived the idea of founding in this country a journal worthy of the contributions to the Art and Science of Surgery which England and the British Empire were making. Difficulties were many, and opposition and indifference were found in high places. But we were not dismayed, and

faith in our venture was fired by this experience. We neither faltered nor wavered, but held steadily to our purpose. In earliest days and throughout twenty years, with the exception of one year when you served in the Army oversea, our activities centred round you. All our plans, all our ambitions, all our efforts, found in you a most willing, most competent, and tireless worker. Your industry, your wise judgement, your enthusiasm and unwearying tact, have been of value beyond reckoning in maintaining year after year our corporate efforts. The doubts and hazards of early years are now displaced by an assured confidence in our work, and hope for the future of the JOURNAL is now secure.

'Incertainties now crown themselves assured'.

"If our JOURNAL is of value to the world of surgeons, to no man can greater credit be given than to you, our faithful, loyal, most diligent and trusted Secretary. To-day and by our simple gift we seek with our affection to assure you of our cordial recognition of your invaluable help, and to say of you and the JOURNAL—

'So long as man can breathe or eyes can see
So long lives this, and this gives life to thee.'"

I am very deeply grateful to the Fellows of the Association of Surgeons and to other subscribers to this Journal who have, through Professor Gask, made me the very handsome gift of a specially designed salver of beaten silver by Omar Ramsden, and a large cheque.

The appreciation of my colleagues will be a great incentive to continue to labour on their behalf and on that of British Surgery.

ERNEST W. HEY GROVES.

SOME EARLY SURGICAL CASES.

By Sir D'ARCY POWER, K.B.E., London.

II. THE EDWIN SMITH PAPYRUS.

(Concluded.)

Passing from head injuries, the surgeon next describes broken noses, first where the cartilage alone is injured, and secondly when the nasal bones are fractured. Of traumatic deviation of the septum, he says:—

Instructions concerning a break in the column of the nose. If thou examinest a man having a break in the column of his nose, his nose being disfigured and a depression being in it while the swelling that is on it protrudes and he has discharged blood from both his nostrils. Thou shouldest say concerning him; "One having a break in the column of his nose. An ailment which I will treat."

Thou shouldest cleanse it for him with two plugs of linen. Thou shouldest place two plugs of linen saturated with grease in the inside of his two nostrils. Thou shouldest put him at his mooring stakes until the swelling is reduced. Thou shouldest apply for him stiff rolls of linen by which his nose is held fast. Thou shouldest treat him afterwards with grease, honey and lint every day until he recovers.

Instructions concerning a break in the chamber of the nose. If thou examinest a man having a break in the chamber of his nose and thou findest his nose bent while his face is disfigured and the swelling which is over it is protruding. Thou shouldest say concerning him "One having a break in the chamber of his nose. An ailment which I will treat." Thou shouldest force it to fall in so that it is lying in its place. Clean out for him the interior of both his nostrils with two swabs of linen until every worm of blood which coagulates in the inside of his two nostrils comes forth. Now afterwards thou shouldest place two plugs of linen saturated with grease and put into his two nostrils. Thou shouldest place for him two stiff rolls of linen bound on. Thou shouldest treat him afterwards with grease, honey and lint every day until he recovers.

The editor adds as a gloss, "A break in the chamber of his nose." It means the middle of his nose as far as the back extending to the region between his two eyebrows.

Another case appears to be a lateral sinus thrombosis. The surgeon writes of:—

A wound of the temple. Instructions concerning a wound of the temple penetrating to the bone and perforating his temporal bone. If thou examinest a man having a wound in his temple penetrating to the bone and perforating his temporal bone, while his two eyes are bloodshot, he discharges blood from both his nostrils and a little drops; if thou puttest thy fingers on the mouth of that wound and he shudders exceedingly; if thou ask of him concerning his malady and he speaks not to thee while copious tears fall from both his eyes so that he thrusts his hand often to his face that he may wipe both his eyes with the back of his hand as a child does and knows not that he does so. Thou shouldest say concerning him "One having a wound in his temple penetrating to the bone and perforating his

temporal bone while he discharges blood from both his nostrils, he suffers with stiffness of the neck and is speechless. An ailment not to be treated. Now when thou findest that man speechless, his relief shall be sitting; soften his head with grease and pour milk into both his ears."

In other words there is nothing to be done for him.

A dislocation of the lower jaw:—

If thou findest a man having a dislocation of his lower jaw, shouldest thou find his mouth open and his mouth cannot close for him, thou shouldest put thy thumbs upon the ends of the two rami of the mandible in the inside of his mouth and thy two claws under his chin and thou shouldest cause them to fall back so that they rest in their places. Thou shouldest say concerning him "One having a dislocation in his mandible. An ailment which I will treat." Thou shouldest bind it with ymrw and honey every day until he recovers.

The meaning of the word 'ymrw' is unknown.

The most surprising of the cases quoted is the following. It is headed:—

Instructions concerning a dislocation in a vertebra of his neck. If thou examinest a man having a dislocation in a vertebra of his neck, shouldest thou find him unconscious of his two arms and his two legs on account of it, whilst his penis is erect on account of it and urine drops from his member without his knowing it; his flesh has received wind; his two eyes are bloodshot. It is a dislocation of the vertebra of the neck extending to his backbone which causes him to be unconscious of his two arms and his two legs. If, however, the middle vertebra of his neck is dislocated it is an emissio seminis which befalls his penis. Thou shouldest say concerning him "One having a dislocation in a vertebra of his neck while he is unconscious of his two legs and his two arms and his urine dribbles. An ailment not to be treated."

The editor adds: As for "It is an emissio seminis which befalls his phallus" it means that his penis is erected and has a discharge from the end of his penis. It is said it remains stationary when it cannot sink downward and it cannot lift upward.

The surgeon has undoubtedly seen a patient with a severe injury to the spine involving the cord, for he notes the paralysis and priapism, saying wisely that he cannot cure him. He also distinguishes between a cervical sprain and a fracture-dislocation. Of a sprain he says:—

Instructions concerning a displacement in a vertebra in his neck. If thou examinest a man having a displacement in a vertebra of his neck, whose face is fixed, whose neck cannot turn for him and thou shouldest say to him "Look at thy breast and thy two shoulders" and he is unable to turn his face that he may look at his breast and his two shoulders. Thou shouldest say concerning him "One having a displacement in a vertebra of his neck. An ailment which I will treat."

Of a fracture-dislocation he says:—

Instructions concerning a crushed vertebra in his neck. If thou examinest a man having a crushed vertebra in his neck and thou findest that one vertebra has fallen into the next one, while he is voiceless and cannot speak; his head, falling downwards, has caused that one vertebra crush into the next one; and shouldest thou find that he is unconscious of his two arms and his two legs because of it Thou shouldest say concerning him "One having a crushed vertebra in his neck; he is unconscious of his two arms and his two legs and he is speechless. An ailment not to be treated."

The gloss by the editor adds: "His head falling downward has caused that one vertebra crush into the next," it means that he has fallen head downward upon his head, driving one vertebra of his neck into the next.

A fractured clavicle and its treatment was well known to the old surgeon. He says :—

"One having a break in his collar-bone. An ailment which I will treat." Thou shouldest place him on his back with something folded between his two shoulder blades; thou shouldest spread out his two shoulders in order to stretch apart his collar bone until that break falls into its place. Thou shouldest make for him two splints of linen and thou shouldest apply one of them on the inner side of his upper arm and the other on the under side of his upper arm. Thou shouldest bind it with ymrw and treat it afterward with honey every day until he recovers.

Three forms of fracture of the humerus are noted. The first a simple fracture which he says confidently "I will treat"; a second form where a simple fracture is associated with some laceration of the soft tissues—"An ailment with which I will contend"; and lastly a compound fracture with hæmorrhage, "An ailment not to be treated", for seemingly this ancient surgeon had no means of arresting hæmorrhage—or was frightened of blood.

The next case is an acute mammary abscess which had been allowed to progress until it was pointing and had become loculated. It runs :—

If thou findest a man having tumours with a prominent head in his breast and thou findest that the swellings have spread with pus over his breast and have produced redness while it is very hot therein when thy hand touches him. Thou shouldest say concerning him "One having tumours with prominent head in his breast and they produce cysts of pus. An ailment which I will treat with the fire-drill."

This means that the abscesses were to be opened with a red-hot cautery.

The following case shows that the surgeon had seen either a caseating tuberculous osteitis of the sternum or ribs, or was describing a new growth; the former seems the more likely. He says :—

Instructions concerning bulging tumours on his breast. If thou examinest a man having bulging tumours on his breast and thou findest that swellings have spread over his breast; if thou puttest thy hand upon his breast upon these tumours and thou findest them very cool, there being no fever at all therein when thy hand touches him; they have no granulations, they form no fluid, they do not generate secretions of fluid, and they are bulging to thy hand. Thou shouldest say concerning him "One having bulging tumours. An ailment with which I will contend."

Case 48 is headed :—

Instructions concerning a sprain in a vertebra of his spinal column. If thou examinest a man having a sprain in a vertebra of his spinal column, thou shouldest say to him; "Extend now thy two legs and contract them both again." When he extends them both he contracts them both immediately because of the pain he causes in the vertebra of his spinal column in which he suffers. Thou shouldest say concerning him "One having a sprain in a vertebra of his spinal column. An ailment which I will treat." Thou shouldest place him flat on his back; thou shouldest make for him . . . . .

The roll ceases abruptly here. What happened to the editor? What became of the ancient papyrus upon which he was working? The fate of both is lost for ever.

The extracts in this article are taken from Prof. J. H. Breasted's translation of the Edwin Smith Papyrus published by the University of Chicago Press in 1930.

CARCINOMA OF THE KIDNEY.

By GRAHAM SIMPSON,

SENIOR SURGEON, ROYAL HOSPITAL, SHEFFIELD.

Since the classical paper by Grawitz in 1883, much has been written on the diagnosis of renal hypernephroma and on the vexed question of its pathology; this is probably the reason that the interest shown in the other neoplasms has suffered from a temporary eclipse.

A study of the literature proves that, though carcinoma of the kidney is recognized as a sufficiently well defined form of renal growth, its description is limited usually to specimens obtained by operation or at autopsy, and little or no attempt is made to distinguish it clinically.

In a recent text-book on surgical pathology the author divides renal growths into two groups: *the hypernephroma or Grawitz* type and *the embryoma or Wilms* type, and he states that "It will be found that the vast majority of tumours encountered in actual practice can be placed in one or other of these groups". In my opinion such a statement is misleading. Whilst it is unlikely that many cases of carcinoma of the kidney will come within the ken of any general surgeon, recent experience has convinced me that these tumours are far from uncommon; moreover, they may present certain quite characteristic symptoms, the recognition of which is of great importance; otherwise, some patients will undergo a dangerous and unnecessary operation.

Before discussing the symptoms incidental to this form of growth and the complications peculiar to it, I will give the history of a case in which I was able to make such a diagnosis and to predict, with some accuracy, the future of the patient.

CASE REPORT.

Mrs. H., aged 60. In October, 1930, I was asked to see her for subacute intestinal obstruction; she had been poorly since June and had complained of constant severe pain in the back.

She was admitted to a nursing home, where a turpentine enema at once relieved the obstruction, which was obviously due to fæcal impaction; a barium enema was then given and the colon shown to be normal.

On going more closely into her history, she recalled that, some two years before this, she had suffered from a sharp hæmaturia which had continued for several days. Her medical man was just about to ask me to see her when the bleeding ceased, the consultation was cancelled, and the patient went away for a holiday. She had never noticed blood in her urine since that one occasion.

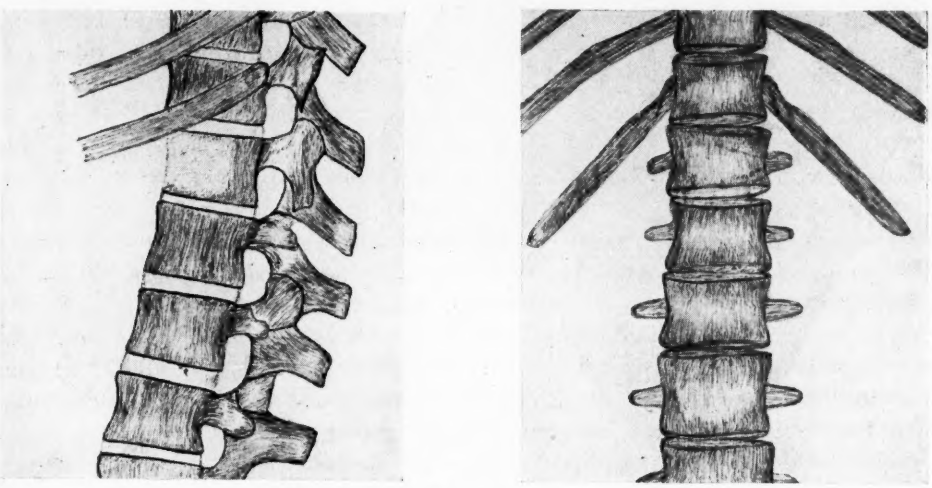
The distension of the abdomen had now subsided, and I again examined her, but I was unable to feel either kidney and there was no tenderness in either loin. The urine was clear and contained neither blood nor pus, but there was a well-marked cloud of albumin.

I now ventured to suggest to her doctor that this woman was suffering from a carcinoma of the kidney, though which organ was affected I could not say; that a

cystoscopy would reveal that one kidney was out of action; that an X-ray examination would demonstrate disease of one or more of the lumbar vertebræ; and that she would become paraplegic and die in a very short time.

A chromocystoscopy showed a normal bladder and ureteric orifices; from the right ureter blue appeared in three and a half minutes, but none came from the left in fifteen minutes. The X-rays showed caries of the body of the first lumbar vertebra with partial collapse (*Figs.* 265, 266). The pain in the patient's back continued to be so terrible that it was with difficulty controlled by morphia; she rapidly went downhill, soon became unable to move her legs, and died six weeks after I first saw her.

I obtained consent for an autopsy, and the illustration (*Fig.* 267) represents the left kidney and part of the dorsal and lumbar spine. The kidney, though almost entirely replaced by growth, is hardly larger than normal; it measures 4½ in. (11·4 cm.) in length and 2½ in. (6·3 cm.) in breadth; very small portions of the kidney can still be made out at the lower pole and on the outer side.



FIGS. 265, 266.—Showing caries of body of first lumbar vertebra and partial collapse.

Around the pedicle is a mass of firm fibro-fatty tissue in which the renal pelvis is buried and cannot be seen; in this mass is included the adrenal, which is also infiltrated with growth; this fibro-fatty mass extended to the side of the vertebral body, but was not firmly adherent to it.

The body of the 1st lumbar vertebra is largely replaced by growth; at this level the spinal column was quite soft and could be freely bent; as a result of this softening the intervertebral discs above and below had been pressed together. There were also some deposits in the body of the 2nd lumbar vertebra.

Sections were cut of the left kidney (*Fig.* 268) and of the body of the 1st lumbar vertebra (*Fig.* 269), and they show that the growth is a typical infiltrating carcinoma. There is no attempt at the formation of tubules, but in various places the arrangement of the cells and their staining reactions strikingly recall the structure of a carcinoma of the bladder; possibly this tumour started in the transitional epithelium of the pelvis or calices.

REMARKS ON THE DIAGNOSIS AND PATHOLOGY.

During the last five years three similar cases have come under my care, and in each of them the clinical picture was so striking as to be quite characteristic:—

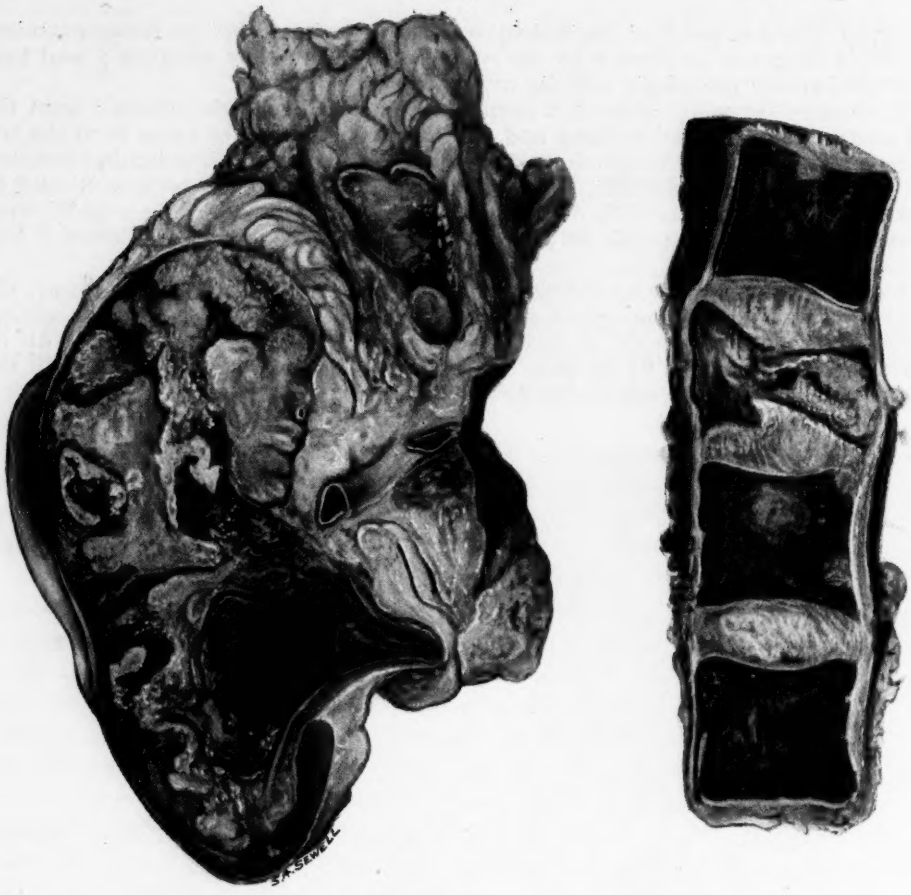


FIG. 267.—Left kidney and part of dorsal and lumbar spine. (× ⅔.)

FIG. 268.—Carcinoma of kidney. (× 250.)

FIG. 269.—Secondary deposit in spine. (× 250.)

1. They all complained of severe pain in the back, which was constant and quite unaffected by exercise.

2. They had all noticed hæmaturia at some period of their illness.

3. In every case the X-rays revealed collapse of one or more of the lumbar vertebræ.

4. Paraplegia developed shortly before their death.

In three out of the four neither kidney could be felt in spite of repeated attempts; in the fourth it was doubtful whether the lower pole of the right kidney was palpable. Probably it was, for the patient complained of tenderness when examined, and the X-rays showed some enlargement of the kidney on that side.

Of these patients three were men, aged 64, 63, and 41; the one woman was aged 60. The growth was localized by cystoscopy twice in the right kidney and twice in the left.

In the first of these cases, the man of 41, the kidney was removed, for I had not then realized the true significance of the pain in the back. The operation was difficult, for the kidney was adherent and its pedicle short. He survived the operation for three months, but his pain was not relieved and he died paraplegic.

From my limited experience it would seem that the diagnosis of carcinoma of the kidney can be made with confidence in any patient who presents the three phenomena—an intense and constant pain in the lumbar spine, a history of hæmaturia, and the absence of any obvious enlargement of either kidney. The finding of albuminuria, cystoscopic evidence of the suppression of the function of one kidney, and the X-ray findings of collapse of one or more vertebræ complete the diagnosis and prove which is the affected kidney. Unfortunately, they also show quite conclusively that the tumour is inoperable.

In such cases the diagnosis depends largely on the absence of any marked increase in size of the kidney; this is in striking contrast with the other renal growths, in which an obvious tumour is felt and sometimes seen. This peculiarity must be due to the infiltrating and destructive character of the growth; the kidney tissue is replaced and not displaced as it is in the hypernephromata. An exception must be made for those neoplasms which originate in the kidney pelvis and give rise to a secondary hydronephrosis. In my experience such carcinomata affect the papillary form of growth, are less malignant, and do not lead to extension to the vertebral bodies.

As the minute structure of some of these infiltrating carcinomata suggests an origin in transitional epithelium, it is possible that they start in the minor calices and spread into the kidney substance instead of over the surface of the pelvis; there seems to be little proof that their origin is from the epithelium of the renal tubules.

From our present knowledge of the pathology of neoplasms of the kidney one might hazard a temporary classification into the tumours of childhood, which are thought to be due to *misplacement*; the Grawitz tumour, which grows chiefly by *displacement*; and the carcinoma, which is characterized by *replacement*.

Mr. Jocelyn Swan, in an excellent paper recently published, places the Grawitz tumour amongst the carcinomata, and he is supported in this by

some of the modern pathologists. There can be no doubt that, from a study of their minute structure, it is impossible to draw any absolute line between them; in other words, the Grawitz tumour does not 'breed true'. Nevertheless, in spite of the difficulty in distinguishing them microscopically, I consider that an attempt should be made to keep the old nomenclature.

The Grawitz tumour can be recognized clinically and by naked-eye examination; it has a characteristic colour, it is at some stage of its growth encapsulated, and, if diagnosed early, gives an occasional brilliant surgical success. The infiltrating carcinoma also has its characteristic mode of growth,

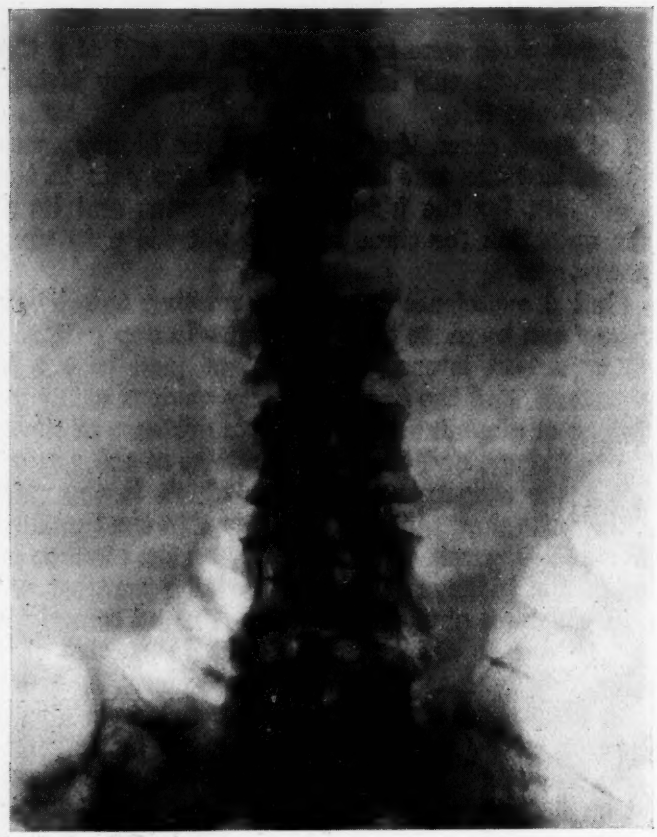


FIG. 270.—Showing invasion of right half of 1st lumbar vertebra.

shows no sign of encapsulation at any period of its existence, and is much more fatal.

Great emphasis has of late been laid on the importance of *hæmaturia*; the vital necessity of considering this as a symptom and not as a disease is fully supported by these cases. In every one of these patients blood in the urine was the first sign of there being anything amiss; usually it had appeared a long time before I saw the patient and had never recurred.

The *pain* is very intense, and is generally referred to the lumbar spine; in one case it was felt also in the course of the external cutaneous nerve of the thigh. In only one of my cases was it felt in the loin as well as in the

back. Since it is not felt along the nerves of the lumbar plexus it is unlikely that it is caused by compression of these nerves in the spinal foramina. It may be compared to the pain which accompanies compression fractures of the vertebræ or to that complained of by patients with carcinoma of the breast who are the subject of secondary deposits in the spine. It is a curious fact that the erosion of the vertebral bodies with subsequent collapse due to tuberculosis is not associated with much local pain, though a typical girdle pain may be present.

The most striking finding in this group of cases was the constant presence of *collapse of one or more of the vertebral bodies*; in each case this was shown by the X-rays; in the 1st lumbar in two cases and in the 2nd and 3rd in the others. The strict localization to the three upper lumbar vertebræ suggests a local spread, presumably through the lymphatics. This view is supported by a case published by Professor John Fraser, of Edinburgh, to whose courtesy I am indebted for permission to reproduce *Fig.* 270. In this case, also one of carcinoma of the kidney, only that half of the vertebral body is affected which is on the side of the growth.

Another noticeable feature is the early onset of a profound *cachexia*; this has been mentioned by Israel as characteristic of renal carcinoma.

TREATMENT.

At this stage of the disease attempts to relieve the terrible pain in the back seem to be the only indication; one patient required 6 gr. of morphia in the twenty-four hours to make life at all tolerable. What is to be done in the future for these unhappy individuals?

In a recent speech Sir Buckstone Brown said that Nature's method was "a word and a blow", and it would be hard to find a more apt example than the mode of onset of this disease: the word of warning, the symptomless hæmaturia, followed months or years later by the pain in the back which makes the diagnosis simple and treatment hopeless.

If, as it seems to me, the one hope lies in earlier diagnosis, our students should be taught to look on hæmaturia as a surgical emergency. If this were done and such patients sent at once to a nursing home or a hospital for immediate cystoscopy, we might occasionally come across a carcinoma of the kidney in time for a successful operation. At the present time nephrectomy for such tumours does little more than enrich the local pathological museum.

Unfortunately the hæmaturia precedes the pain and it may be difficult to persuade the patient to submit to the inconvenience of a cystoscopy. In some cases, owing to delay in getting a bed, the bleeding has stopped before the patient is admitted, and either a cystoscopy is refused or it is impossible to tell from which side the bleeding came.

Great hopes have been raised by the advent of pyelography and its more recent developments, but I doubt whether the original method of 'infusion pyelography' will be of much help in early cases of this disease. Even in advanced cases there is little deformity of the kidney and its pelvis, and it is common knowledge that the pelvis and calices of normal kidneys show great variation in outline. Not only so, but the taking of bilateral pyelograms

and the comparison of the suspected kidney with that of the opposite side may mislead, for, in my experience, the arrangement of the pelvis and calices is not always symmetrical. If to this we add the possible presence of filling defects due to blood-clot and the effects of over- and under-distension, I feel I am justified in my pessimism.

There is, however, a brighter side to the picture; the use of uroselectan, 'excretion urography', though it may fail to demonstrate the form of the pelvis and calices, almost certainly is an indicator of the function of the kidney. In a recent paper on this subject, Mr. Henry Wade, of Edinburgh, asserts that, whilst the infusion method may fail to help in the diagnosis of this form of growth, the excretion method may show an entire absence of shadow. I have not yet had the opportunity of confirming his observations, but they seem to me to be the most hopeful yet made on the diagnosis of this disease.

I feel that this is a real advance, for there are many patients, especially men, who would consent to an intravenous injection but would object to a cystoscopy which might be prolonged and might have to be repeated. Then again the injection can be made by a resident and does not demand the skill necessary for cystoscopy.

Even if the patient has been cystoscoped at once and the bleeding traced to one kidney, our difficulties are not at an end, for a surgical problem of some delicacy arises when the suspected kidney is exposed on the loin and is found to look and to feel perfectly normal.

There can be no doubt that, if such an organ is stripped of its capsule, or if it is fixed in the loin, or if it is simply returned to its original site, a certain number of these cases cease to bleed and are reported to be in good health many years later. I have not adopted this line of treatment, for I felt that, sooner or later, I should in this way miss a case of early tumour.

Another method is to split the kidney longitudinally and examine the cut surfaces and the pelvis and calices; they can be inspected quite efficiently if the renal pedicle is compressed. After exploring a good many kidneys in this way I gave it up because I consider there are three grave disadvantages.

1. The first and greatest is that, in spite of careful suture of the two halves, I have had several instances of very severe hæmorrhage a few days later, and this has occurred notwithstanding the fact that, at the subsequent nephrectomy, the sutures were still holding.

2. The second is that such a kidney after a secondary removal may show numerous large infarcts—a proof that the blood-supply has been seriously interfered with. I feel doubtful whether such damaged organs are of much use afterwards.

3. The last is that one might replace a kidney which was the seat of an early growth; even the hemisection shows only two surfaces, and a small tumour to one or other side of the plane of section might conceivably be missed by the most careful of surgeons.

Still another and more radical procedure is to do a nephrectomy, and to this course I have been driven by the rule that I have formulated for myself that " more can sometimes be learnt of the pathology of a kidney by the examination of its separated urine than by its exposure on the loin ".

Perhaps the best example of this is the early tuberculous kidney, which looks normal when exposed at operation but the urine from which has been found to contain pus and tubercle bacilli.

My practice for some years has been to remove the kidney, have it hardened, and to open it and have it examined some weeks later. In this way I have met with some interesting findings—a nævus of a papilla and very early tubercle of one papilla. My colleague, Mr. J. C. Anderson, has recently published in this JOURNAL an example of a tiny papilloma of a papilla which gave rise to sharp bleeding. The following is a still more striking case :—

In October, 1930, a man aged 37 was admitted under my care for hæmaturia of two weeks' duration ; his only other complaint was of pain in the left iliac fossa which was felt on passing water.

He looked quite healthy and nothing abnormal was found on examination except the bleeding, which was traced to the right kidney. This was removed ; it looked normal, but the pelvis and ureter were distended with blood.

On cutting into the kidney the uppermost calix was found to be full of blood and the two highest papillæ had a peculiar velvety appearance. Sections were cut of these papillæ and they show a curious change in the tissue immediately under their tips ; the accompanying illustration (*Fig.* 271) shows that they closely resemble a section of hypernephroma. The change was limited to the two upper papillæ and was not present in the papilla just below.

FIG. 271.—Section of papilla.

I hesitate to call this a case of very early tumour, for the changes are slight and confined to so small a part of the organ ; moreover, Dr. Harold E. Harding very kindly studied the sections for me and his report (which is given at the end of this paper) is definitely against the view that these changes are neoplastic.

Nevertheless, in spite of the dubious nature of the lesion, the bleeding was severe, and I feel that I was justified in my choice of treatment ; I am confident that many surgeons, on looking at this section, would feel little doubt that it was from a hypernephroma. It is hardly necessary to add that the patient is alive and quite well.

Leaving aside for the moment the question whether nephrectomy for symptomless hæmaturia is a sound form of treatment, I must admit that there are some tumours of the kidney which are perfectly hopeless in the present state of our knowledge. The following case is an example :—

Boy, aged 17, admitted to the Sheffield Royal Hospital for hæmaturia of only three days' duration ; he had had no previous symptoms and looked to be in perfect

health. The bleeding was traced to the left kidney, and this was removed four days later; the pelvis and the lower pole were noticed to be unusually adherent; otherwise the organ looked quite normal. (*Fig.* 272.)

The kidney was hardened, and when it was cut across a cyst was found in the lower pole containing blood and clot; projecting into its cavity was a polypus, the size of a cherry-stone; a section of this showed spindle-celled sarcoma.

The growth recurred *in situ* within six months, and on readmission of the patient was found to be inoperable; it spread with frightful rapidity until it filled half the abdominal cavity, caused the most intense suffering, and destroyed the patient in a few weeks.

This rapid recurrence was the more surprising as the kidney had been removed intact and only cut open some weeks later, so that the question of the soiling of the wound with tumour cells can hardly be entertained.

FIG. 272.—Sarcoma of kidney.

Such a lamentable result after removal of a tumour only four days after the first symptom makes one wonder whether we are justified in telling the public that the cure of cancer is only a question of early diagnosis.

But there is another side to the question of nephrectomy for symptomless hæmaturia: I have to admit that, on several occasions, I have removed such kidneys and that nothing abnormal has been found after the most careful examination to account for the hæmaturia.

On the whole, my experience in the search for early kidney tumours has been disappointing. I have removed some kidneys which might presumably have stopped bleeding and not given any future trouble. I have removed a kidney seven days after the first bleeding and the patient was dead of a sarcoma in six months. The tumours I have found have been mostly innocent and might perhaps have been cured by less radical methods than nephrectomy, and the one case in which I thought I had discovered an early hypernephroma is not considered by the pathologist to be neoplastic at all.

Nevertheless, I have thought it worth while to record my experience, if only to direct the attention of other surgeons to this very difficult and unsatisfactory problem.

HISTOLOGICAL REPORT.

BY HAROLD E. HARDING.

The cells of the collecting tubules are large and columnar. The rounded nuclei are rather darkly staining; most of them have a single nucleolus and a dense reticulum; they are nearer to the basement membrane than to the margin of the cell.

The cytoplasm is extremely thin, so that a well-marked cell membrane appears to enclose a space very imperfectly filled with a little finely granular cytoplasm, and in which the nucleus has no visible means of support. The appearance of these cells is not unlike that of the so-called 'hypernephroma'. Obviously a large proportion of the cell content has been dissolved out in preparation of the section.

These appearances are most marked at the inner surface of the renal pyramid, but can be traced inwards for at least a quarter of an inch, the cells becoming rather less columnar and more cubical.

In most cases the tubules have only a single layer of epithelium, but cutting on the slant at places gives a layered appearance. In the largest tubules, however, the epithelium becomes two or three cells thick and there is a notable tendency for papillary projection into the lumen of the tubule. In every case the cells of the collecting tubules are confined within their basal membrane.

I do not consider the condition to be neoplastic.

RIGHT PARADUODENAL HERNIA.

By A. C. HALLIWELL,

SURGEON, JERSEY GENERAL HOSPITAL.

There are two types of hernia into peritoneal fossæ in the neighbourhood of the duodenojejunal flexure, the right and the left paraduodenal. Of these, the former is by far the rarer, only 35 cases having been recorded, whereas there are 105 cases of the left paraduodenal hernia in the literature. Of the 9 peritoneal fossæ in this region described by Lord Moynihan,[1] only 2 or possibly 3 are of surgical importance. These are :—

1. *Left Paraduodenal Fossa of Landzert.*—This is situated on the left side of the duodenojejunal flexure, and the orifice looks towards the right. It is a pouch of peritoneum pushed beneath the inferior mesenteric vein, which consequently lies in its right free margin, and a hernia in this fossa is known as a 'left paraduodenal' hernia.

2. *Right Mesenterico-parietal Fossa of Waldeyer.*—This is situated below the duodenum and is bounded in front by the mesentery of the jejunum. Its orifice looks towards the left, and the superior mesenteric artery lies in its left free margin. Moynihan, writing in 1906, stated that he had only met with a distinct fossa in adults on three occasions, but in seventeen embryos of less than five or six months he noticed six fossæ. It is believed that the majority of cases of right paraduodenal hernia are in connection with this fossa.

3. *Inferior Duodenal Fossa of Treitz.*—Klob, who first described right paraduodenal hernia in 1861, believed that the hernia entered the inferior duodenal fossa, which lies at the left side of the termination of the duodenum, and progressed towards the right by peeling back the superior peritoneal margin until the superior mesenteric artery is reached. This would produce a typical right paraduodenal hernia. Nagel[2] considers that some of these herniæ probably do arise in this way, although the majority are in connection with the mesenterico-parietal fossa. The inferior duodenal fossa is common, being found in 60 to 70 per cent of cases.

Moynihan states that the following conditions are invariably present in right duodenal hernia : (1) The sac occupies, at any rate at first, the right half of the abdomen, lying behind the ascending and transverse mesocolon ; (2) The orifice is situated behind and to the left of the sac ; (3) In the anterior margin of the sac is either the superior mesenteric artery or its continuation, the ileocolic artery. In the case described below these three conditions were present.

The literature on this variety of duodenal hernia was reviewed by Nagel[2] and again by F. R. Brown,[3] who summarized the 32 cases recorded to that date. In 1929 Taylor[4] added 2 more and described the first case to be

diagnosed before operation or necropsy. A further case was reported by Dowdle[5] in 1932. Of these 35 cases, 18 were operated upon, the remaining 17 being found at necropsy. There have been only 7 recoveries from the operation.

CASE REPORT.

A. J., a man aged 38, was admitted to the Jersey Dispensary and Infirmary in May, 1932, with twelve months' history of pain across the lower abdomen. The pain was colicky in nature and was brought on by food, appearing usually about half an hour after meals. At the beginning of his illness there were days of complete freedom from pain, even as long as two weeks, but during the two or three months previous to admission it occurred after every meal and lasted

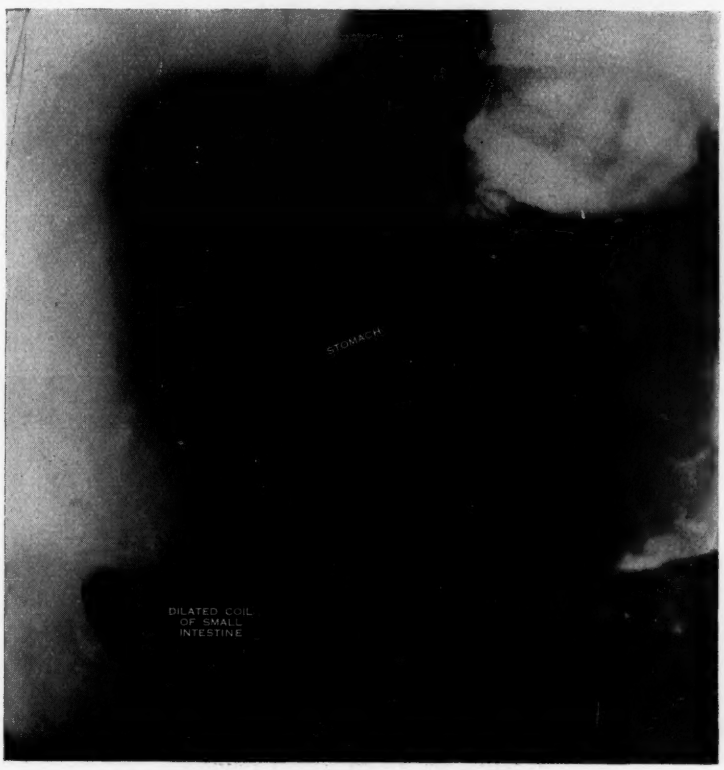


FIG. 273.—X-ray appearance immediately after meal.

till he vomited, after which the pain was relieved. His appetite was good, but he was afraid to eat.

ON EXAMINATION.—The patient appeared well nourished. There was slight abdominal distension, and in the upper left quadrant visible peristalsis was noted. X-ray examination showed dilated coils of small intestine bunched together, chiefly on the right side of the abdomen (*Figs.* 273–277).

DIAGNOSIS.—A diagnosis was made of chronic small intestine obstruction, probably retroperitoneal hernia. After the operation, when the films were compared with those published by Taylor[4] in the BRITISH JOURNAL OF SURGERY, it was felt that the diagnosis should have been made more accurately.

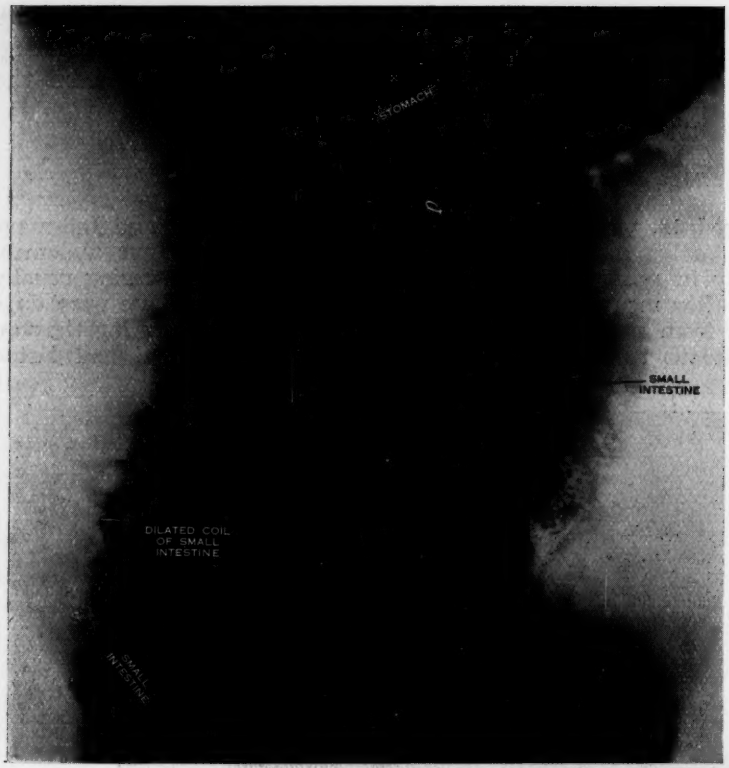


FIG. 274.—One hour after meal.

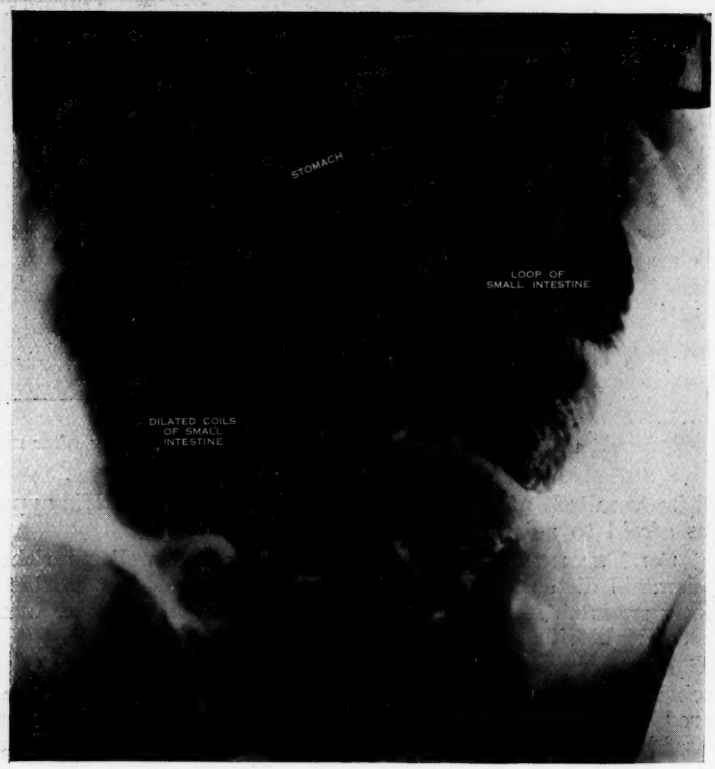


FIG. 275.—Two hours after meal—prone position.

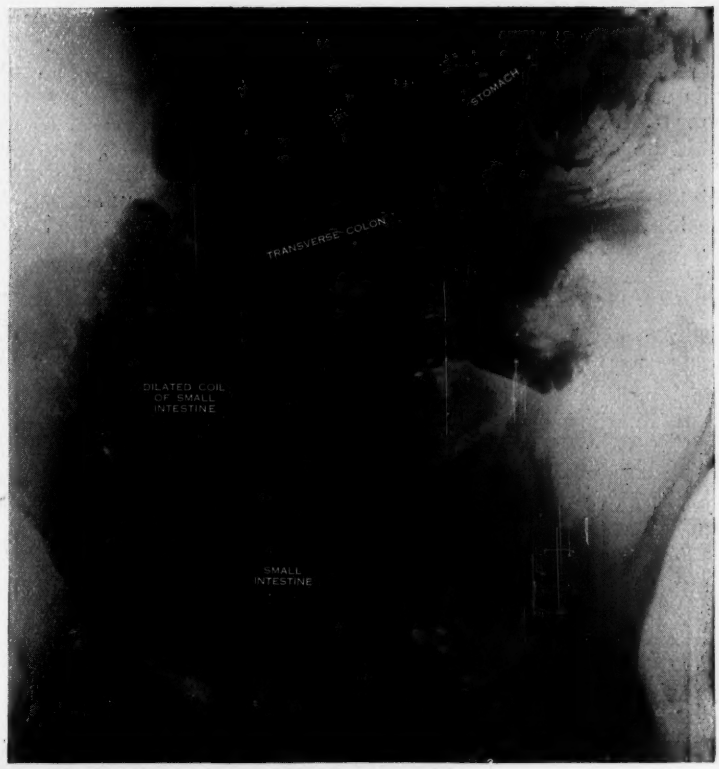


FIG. 276.—Six hours after meal.

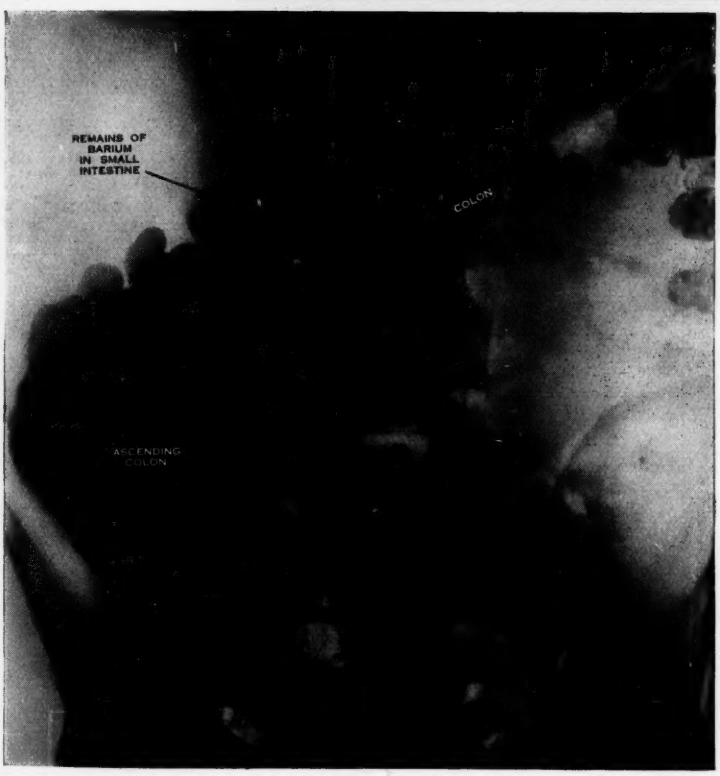


FIG. 277. — Twenty-four hours after meal.

OPERATION.—The abdomen was opened by a right paramedian incision and revealed the condition shown in the drawing (*Fig.* 278). There appeared to be three large loops or coils of bowel and no small intestine visible anywhere. These coils overlapped the ascending and descending colon. The membrane covering the loops was moderately thick, and although the individual coils of small intestine could be seen through, they were not as clear as appears in *Fig.* 278. We were obviously dealing with a retroperitoneal hernia, and the origin was found in the neighbourhood of the duodenojejunal flexure. The mouth of the sac looked towards the left, and over it the superior mesenteric artery could be felt. An attempt was

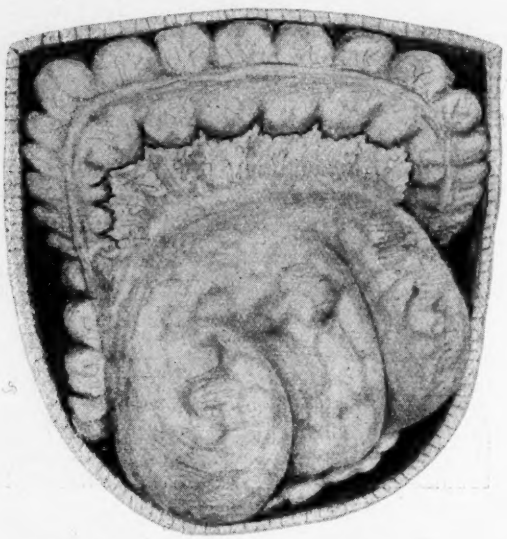


FIG. 278.—Condition found at operation.

made to withdraw the bowel, but this was found to be impossible owing to adhesion of the entering and returning loops at the mouth of the sac; consequently an opening was made into the front of the sac to investigate the condition inside. There was only one layer of peritoneum, and the serous coat of the bowel was completely adherent to the wall of the sac. It could be peeled off without difficulty, but left an intestine devoid of its serous coat; consequently the hole made in the sac was closed. The neck of the sac was examined again and divided on its inferior aspect, freeing the entering and returning loops as far as possible, after which the abdomen was closed.

SUBSEQUENT PROGRESS.—There was a good deal of post-operative vomiting, and for a few days it appeared as if the chronic obstruction had been converted into an acute one. Finally, however, the patient made a good recovery, and nine months later was reported as at work and free from symptoms.

COMMENTARY.

Although the patient cannot be considered cured, he has been relieved of his symptoms by division of the neck of the sac, and indeed it is difficult to see what else was possible. Brown was able to turn the sac inside out, ligature it at the neck, and remove it. In this case there was no sac and it was not a true herniation. The obvious suggestion is that the intestine had burst through the wall of a small sac and had insinuated itself behind the posterior parietal peritoneum. But there are many objections to this theory,

and these have been clearly stated by Edmund Andrews,[6] who maintains that the term 'duodenal hernia' is a misnomer and that the condition is a "congenital anomaly due to imprisonment of the small intestine beneath the mesentery of the developing colon". His arguments are convincing and well bear repetition. It is difficult to imagine a force which will continue to act until all the small intestine has been segregated into a sac, leaving the abdominal cavity empty. There are many similar folds and fossæ in the peritoneal cavity, some of which are larger than the duodenal fossæ, and are practically never the site of a hernia. The herniated viscus is always small intestine, and practically the whole of the small intestine: the presence of omentum has never been reported. Finally a case of total hernia has been reported by Vogt in a new-born infant (left duodenal).

The case reported above is consistent with an embryological explanation.

I am indebted to Dr. Stamberg, Honorary Radiologist to the Jersey Dispensary and Infirmary, for the series of X-ray photographs.

REFERENCES.

[1] MOYNIHAN, *Retroperitoneal Hernia*, 1906, 2nd ed.
[2] NAGEL, *Collected Papers of the Mayo Clinic*, 1923, xv, 135.
[3] BROWN, *Brit. Jour. Surg.*, 1925–26, xiii, 367.
[4] TAYLOR, *Ibid.*, 1929–30, xvii, 639.
[5] DOWDLE, *Surg. Gynecol. and Obst.*, 1932, liv, 246.
[6] ANDREWS, *Ibid.*, 1923, xxxvii, 740.

TWO CASES OF OSSIFICATION IN THE INTERNAL SEMILUNAR CARTILAGE.*

By H. JACKSON BURROWS,

CHIEF ASSISTANT, ORTHOPÆDIC DEPARTMENT, ST. BARTHOLOMEW'S HOSPITAL.

THE following two cases seem to be of interest as examples of a rarity and as bearing on the problem of the metaplastic formation of bone.

CASE REPORTS.

Case 1.—F. R., Eastern produce merchant, aged 25. Two and a half years previously the patient was running at Rugby football, and as his weight came on the right foot this slipped inwards. He felt a sudden pain internal to the right patella, and was unable to continue the game. The knee became swollen about six hours later, and his activities were limited for three or four days, after which

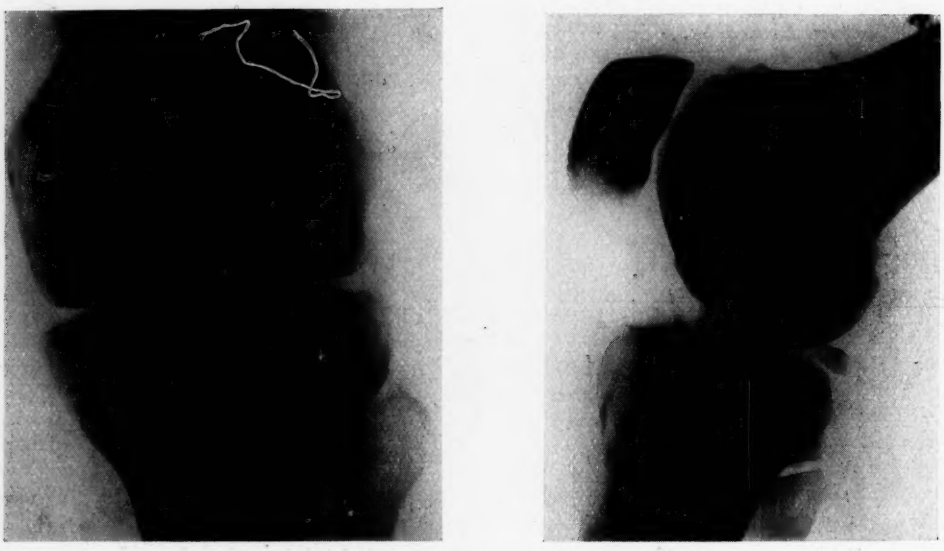


FIG. 279.—*Case* 1. Skiagrams showing opaque body in joint.

the joint felt perfectly recovered. Subsequently, however, the symptoms returned on six or seven occasions. At no time did locking occur.

The only physical sign at the time of examination was slight tenderness in the joint line internal to the patella.

X-ray photographs (*Fig.* 279) showed an opaque body lying in the postero-internal part of the joint.

---

* From the Orthopædic Department, St. Bartholomew's Hospital, and the Cytological Laboratory, Royal College of Surgeons of England.

A diagnosis of loose body (probably due to osteochondritis dissecans) was made.

Operation.—The joint was explored by the postero-internal route. It was found that the posterior horn of the internal semilunar cartilage was absent, the latter ending posteriorly in a club-shaped extremity which was 1 cm. broad and ½ cm. thick, continuous in front with the remainder of the cartilage, but otherwise quite free. It was faceted below by the articular surface of the head of the tibia, was bony hard, and had a pale pink tint which contrasted with the rest of the meniscus. An antero-internal incision was then made and the whole cartilage removed in one piece; the anterior portion showed no abnormality.

Subsequent examination of the specimen (*Fig.* 280) confirmed the above description. The histology is detailed later.

Fig. 280.—*Case* 1. Specimen viewed from above.

Case 2.—B. W., clerk, aged 19. Five years previously the patient had been kicked behind the right knee at football. He continued the game, but afterwards noticed stiffness, and swelling occurred which lasted about a month. Subsequently at football or at other times, when he turned inwards on the right leg, there would be a sudden pain in the postero-external part of the joint which would let him down. This would be followed by aching pain lasting for a period of one to three days. There was never any locking.

No physical signs were present at the time of examination except a click of uncertain origin in the postero-external part of each knee on extension after full flexion.

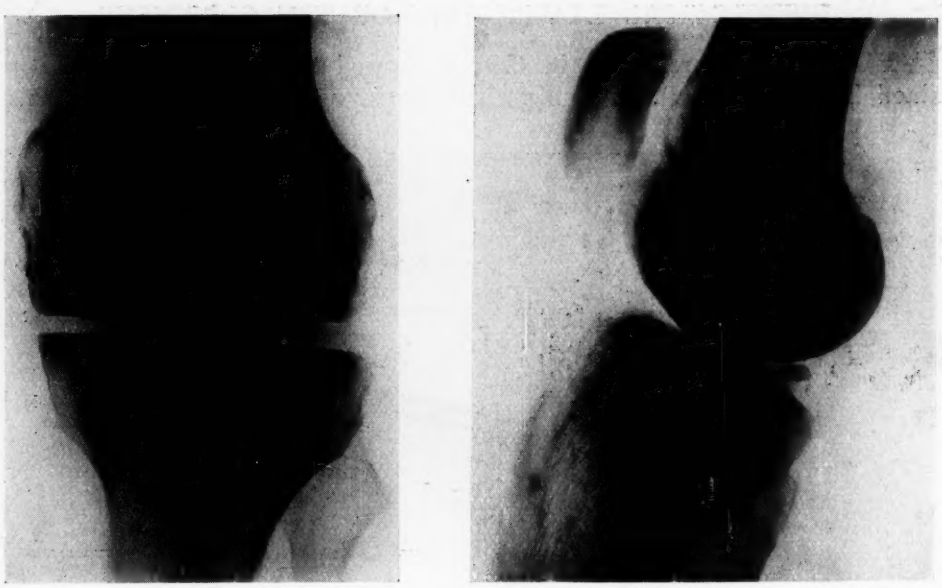


Fig. 281.—*Case* 2. Skiagrams showing opaque body in joint.

Skiagrams (*Fig.* 281) showed an opaque body lying in the postero-internal part of the joint, and a like condition at re-examination four weeks later after splinting prior to operation.

A diagnosis of loose body (probably due to osteochondritis dissecans) was made.

OPERATION.—The joint was opened by a postero-internal incision. The condition of affairs was similar to that found in *Case* 1, except that the abrupt termination of the cartilage consisted of two parts: (1) A hard, club-like, smooth nodule similar to that found in *Case* 1 (except in being faceted above instead of below); and

FIG. 282.—*Case* 2. Specimen showing (*a*) superior, and (*b*) inferior surface.

(2) A ragged tag of fibrocartilage which lay below and slightly internal to the nodule and was separated from it by an irregular split (*Fig.* 282). As much of the cartilage was removed as was possible without making a further incision. About the anterior third remained.

The findings at operation were confirmed by subsequent examination of the specimen.

HISTOLOGICAL EXAMINATION OF THE SPECIMENS.

Histological examination in *Case* 1 showed that the hard nodule contained bone (*Fig.* 283). The fibrocartilage immediately surrounding this is

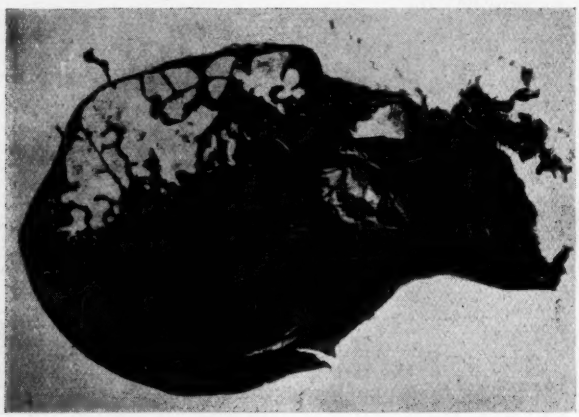


FIG. 283.—*Case* 1. Section of specimen. Note spongy bone above and to the left. (Zenker's fixative; Ehrlich's hæmatoxylin and eosin.) (× 5.)

in places clearly demarcated from the trabeculæ; in other parts there is some tendency to a blending or transition. It shows patches of calcification, and

its cells are increased in number and hypertrophied. Many of them are surrounded by chondrin-balls. While this tissue retains the essential characters of fibrocartilage, its appearance approximates to that of hyaline cartilage. The portion immediately contiguous to the main nodule of bone contains spaces occupied by loose connective tissue and blood-vessels (*Fig.* 284). Some

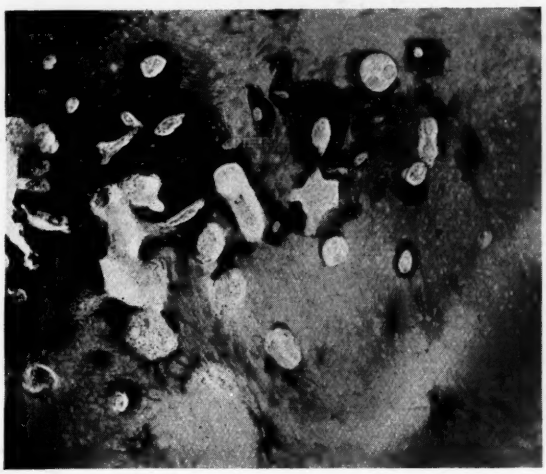


FIG. 284.—*Case* 1. Section of specimen to show the area adjacent to the main nodule of bone. Note the tendency for the early bone to form round the fibrovascular spaces which have appeared in the hyperplastic cartilage. (Zenker's fixative; Mallory's triple stain.) (× 35.)

of these are surrounded or partly surrounded by a thin lamella of bone. Osteoclasts are inconspicuous. The sections suggest that the process of bone formation is as follows:—

1. Hyperplasia of the fibrocartilage, with deposition of calcium; the cells multiply and enlarge and the proportion of matrix to fibres increases.
2. Replacement of areas of cartilage by loose vascular connective tissue.
3. Formation of true bone in the walls of the cavities so formed.

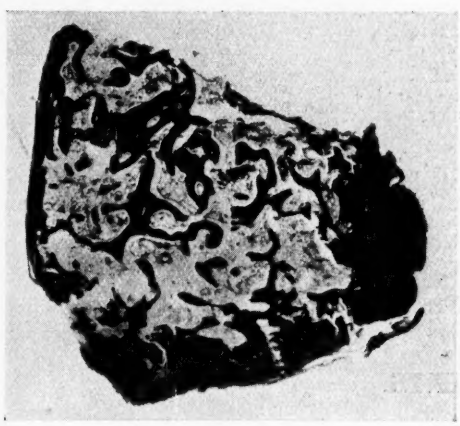


FIG. 285.—*Case* 2. Section of specimen. (Zenker's fixative; Mallory's triple stain.) (× 5.)

The appearances in *Case* 2 (*Fig.* 285) resemble those in *Case* 1 in that the fibrocartilage contiguous to the bone has undergone hyperplasia. They differ in the following particulars. Vascular connective-tissue spaces are relatively absent from the zone of hyperplastic cartilage. In parts the cells

are particularly numerous and may tend to become arranged in rows at right angles to the zone of ossification (*Fig.* 286). The nodule of bone contains

FIG 286.—*Case* 2. Section of specimen to show an area where the numerous cells of the hyperplastic cartilage have become arranged in rows at right angles to the zone of ossification. (Zenker's fixative; Mallory's triple stain.) (× 90.)

several small islands of hyaline cartilage (*Fig.* 287), and there is a thin shell of this overlying a part of the surface.

FIG. 287.—*Case* 2. Section of specimen to show islands of hyaline cartilage. Note the fibrous appearance typical of young bone. (Zenker's fixative; safranin and picro-indigo-carmine.) (× 60.)

COMMENTS.

Clearly considerable caution must be exercised in drawing conclusions from only two cases.

Symptoms, Diagnosis, and Treatment.—Both patients are young men who had received an injury at football a few years previously. Each had been troubled by a return of symptoms from time to time, with apparent

complete recovery in the intervals. Locking had been absent. X-rays showed an opaque body of about the same size in about the same position in each instance.

These points might assist a correct pre-operative diagnosis on another occasion, and might be thought to justify an initial antero-internal incision, through which all that is required could be done. It would be much safer, however, as such a diagnosis must always be a tentative one, to proceed in the manner customary for a loose body in the situation named. Whether an antero-internal incision should subsequently be made and the anterior part of the cartilage removed is a matter of opinion. As yet, it is too soon to know whether the fact that this step was omitted in *Case* 2 will give rise to trouble. Personally I should prefer to do the more complete operation.

Pathology.—The possibility that a preceding congenital abnormality was present cannot be denied.

That the condition is in part, if not wholly, traumatic is suggested by the history and supported by the fact that the second specimen showed all the appearances typical of an old split; both showed histological evidence of osteogenic activity, which would be improbable if the bone had dated from early life.

If the condition is wholly traumatic, the bony nodule in each case must be metaplastic. From the description of the histological appearances in *Case* 1 it is clear that in this instance there is a close resemblance between the process of metaplastic bone formation in fibrocartilage and the normal process of ossification in hyaline cartilage. *Case* 2 also is consistent with this, though giving a less complete picture. The islands of hyaline cartilage in this case may be compared with those sometimes found in heterotopic membrane bone. They differ from the residual cartilage found in areas of recently formed enchondral bone and cannot necessarily be regarded as a stage in the change from fibrocartilage to bone.

The present example of metaplastic bone formation is particularly interesting because it is enchondral. Most examples which have received study have represented ossification of the membrane type.

From histological considerations it would seem that the crucial event is the hyperplasia of the fibrocartilage. In embryonic skeletal rudiments the onset of ossification is preceded by the appearance, in portions of the hyaline cartilage, of the large-celled variety with the formation of phosphoric esterase.[1] The present specimens were not tested for this, but it is difficult to escape from the histological analogy.

Some of the histological appearances in this case of enchondral metaplasia are consistent with Greig's[2] amplification of the theory or hypothesis of Leriche and Policard,[3] whereby the metaplastic formation of membrane bone is believed to result from the revascularization of a region of calcium excess. According to this view, the original injury would cause tissue death and consequent calcification, and the irritation exercised by the calcium, or in this instance by repeated trauma, would bring about revascularization.

SUMMARY.

Two cases of ossification in the internal semilunar cartilage are reported, and the findings are discussed briefly: (1) From the clinical point of view; (2) From the pathological point of view, with special reference to recent work on osteogenesis.

I have to thank Mr. Elmslie for his kind permission to publish these cases and for his encouragement. The drawings and photographs are by Mr. Steward, and the histological preparations by Miss Glasscock.

REFERENCES.

[1] FELL, HONOR B., and ROBISON, ROBERT, "The Growth, Development and Phosphatase Activity of Embryonic Avian Femora and Limb-buds Cultivated *in vitro*", *Biochem. Jour.*, 1929, xxiii, 767.

[2] GREIG, DAVID M., *Clinical Observations on the Surgical Pathology of Bone*, 1931. Edinburgh.

[3] LERICHE, R., and POLICARD, A., *La Physiologie normale et pathologique de l'Os*, 1926. Paris. *The Normal and Pathological Physiology of Bone*, 1928. London.

THE FALLACY OF EXPECTANT TREATMENT IN ACUTE APPENDICITIS.

H. C. WARDLEWORTH NUTTALL,

HON. SURGEON TO OUT-PATIENTS, LIVERPOOL ROYAL INFIRMARY,

THE relative advantages of delayed and immediate operation in acute appendicitis have been so freely discussed during the past few years that the subject is becoming wearisome. In spite of this we appear to be as far from a general agreement as ever. On the whole, recent text-books favour the delayed operation.[16, 18–22] The question cannot remain unsettled. Whether the advocates of immediate operation are justified or not, it can be shown that expectant treatment is based on error and is impracticable except in fully-staffed hospitals.

While all are agreed on immediate operation in the early or unperforated appendix, the real crux of the question is the advisability of operating on the case seen *after* forty-eight hours, with or without a palpable mass.

Table I.—MORTALITY OF OPERATION ON THE DIFFERENT DAYS OF ATTACK (*McNeill Love*).

No. of Days	Inflammation limited to Appendix		Local Peritonitis		Local Abscess		General Peritonitis		Total		Mortality
	R.	D.	R.	D.	R.	D.	R.	D.	R.	D.	Per cent
1	191	1	52	1	20	0	16	1	279	3	1·1
2	264	2	61	2	45	2	69	7	439	13	2·8
3	82	2	79	12	123	8	72	19	356	41	10·3
4	21	0	67	9	71	5	26	8	185	22	10·6
5	8	0	22	2	29	0	12	5	71	7	8·9
6	10	1	31	0	32	1	9	3	82	5	5·7
7	4	0	37	1	11	0	2	1	54	2	3·6
8	7	0	19	1	9	0	1	0	36	1	2·7
9	31	0	32	1	15	0	0	0	78	1	1·2
10+	133	1	88	4	57	1	3	1	281	7	2·4
Total	751	7	488	33	412	17	210	45	1861	102	5·2

R = Recovered. D = Died.

It is stated that " surgical interference appears to be particularly dangerous during the third to fifth days inclusive. During this period natural immunity to infection is exhausted and acquired immunity has not yet been established—that is, the patient is in a 'negative phase'."[13] This statement appears to gain support from *Table I* published by McNeill Love,[2] of which he says: " This table emphasizes the accepted fact that operations from the third to the fifth day carry a high mortality. The mortality of operations on the first day is almost negligible (1·1 per cent), on the second day it is appreciable (2·8 per cent), from the third to the fifth day it is lamentable, being 10·3 per cent for this period. After the fifth day we find the mortality dwindles as the duration of history lengthens."

Table II.—Comparison of Mortality and Age

(*McNeill Love*).

Age	Delayed Cases		Inflammation limited to Appendix		Local Peritonitis		Local Abscess		General Peritonitis		Total		Mortality
	R.	D.	R.	D.	R.	D.	R.	D.	R.	D.	R.	D.	Per cent
0–10	27	2	51	1	41	7	49	5	31	15	199	30	13·1
11–20	132	3	281	2	172	10	107	5	67	22	759	42	5·2
21–30	93	2	189	1	131	6	79	2	39	4	531	15	2·8
31–40	41	3	69	1	57	1	38	1	28	1	233	8	3·3
41–50	32	2	28	0	21	2	41	2	9	3	131	8	5·7
Over 50	4	0	9	1	16	2	17	2	9	2	55	7	11·3
Total	329	12	627	6	438	29	331	16	183	47	1908	110	5·4

R = Recovered. D = Died.

A very serious objection to this table is the absence of the ages of the patients. It is admitted by the advocates of the delayed operation that it is not suitable for children or the aged. Fortunately we are able to correct this table for age periods by reference to another table in the same paper giving the comparison of mortality and age (*Table II*).

It is evident that, if the majority of the patients dying of local or general peritonitis or abscess within the period 3rd to 5th day inclusive falls in the age groups 0–10, 11–20, and over 50, one would expect a much higher mortality. These figures have been surrounded by a thick line in the tables, but for the sake of greater clearness the totals are brought together in *Table III*, where it is shown that the great majority of these deaths occur in the most vulnerable age groups. It must also be borne in mind that these are the very cases which are more likely to reach this period, because diagnosis is admittedly more difficult in children and older people.

From this it follows that the argument, based on these figures, in favour of delayed operation when a patient is seen after the first forty-eight hours

is entirely fallacious. It may be noted here that my figures show no increased mortality within the 3rd to 5th day period. Nor is there, apart from these figures, any pathological evidence whatsoever that the patient is in a 'negative phase' during this period.

*Table III.**

	Local Peritonitis	Local Abscess	General Peritonitis
Total deaths (*Table I*) ..	33	17	45
Deaths 3rd to 5th day inclusive (*Table I*)	23	13	32
Total deaths age groups 0–10, 11–20, over 50 (*Table II*)	19	12	39

* *Note.*—Fifty-five cases, including 8 deaths, are missing from *Table I*, presumably because the length of time before the onset was unknown. This does not influence the result, because whether they fall within the three-day period or not would not make any appreciable difference.

In the second place it is claimed that immediate operation is more frequently responsible for various complications and sequelæ; that drainage is required oftener, with consequent fæcal fistula; and that secondary abscesses and hernia are commoner. This is certainly not true in my experience. If we are to judge from the figures published by McNeill Love,[1] drainage is required much oftener under the delayed system and complications are decidedly more frequent. In 151 cases in which operation was successfully delayed, 61 were drained and 9 suffered various complications. In 77 cases where delay failed and operation became imperative, 73 were drained and 15 suffered from complications, 5 of them fatal—a mortality of 6·5 per cent.

In a recent paper McNeill Love[13] gives the following total mortalities:—

Immediate operation, 5·8 per cent.

Expectant treatment:—

65 per cent resolved—subsequent mortality under 1 per cent.
25 per cent forming local abscess, mortality 4·5 per cent.
10 per cent expectant treatment abandoned, mortality 6 per cent.
Average mortality with expectant treatment, under 3 per cent.

On the strength of these figures it is argued that the inherent defects of the expectant treatment may be condoned; that the extra work and mental strain thrown on all concerned are justified by better results. If this is not true—and it will be shown later that the mortality for the immediate operation in large series of cases is as low as 2·5 per cent—then it is an entirely different matter.

These disadvantages may be fairly illustrated by the description of the routine in a recent text-book[18]: "The delayed treatment of appendicitis *must* be carried out on the threshold of the operating theatre by the surgeon himself, for at any moment operation may become imperative." The pulse-rate is to be recorded on a special chart two-hourly, hourly, or even half-hourly. Vomiting is recorded on a vomit chart, giving the time, the quantity,

and the character. Acetone may be present in the urine after a few days' starvation, and precautions must be taken with regard to anæsthesia if operation becomes inevitable.

It is humanly impossible for the average surgeon to live constantly on the "threshold of the operating theatre". A case quoted by the same author points the moral. This case undergoing delayed treatment collapsed on the fifth day and showed signs of general peritonitis. "Within fifteen minutes gas and oxygen was administered and drainage was instituted both suprapubically and locally. His condition was critical for several days, but he recovered, and six months later appendicectomy was performed uneventfully." This case alone is sufficient to condemn the method in any hospital where a skilled surgeon and a specialist anæsthetist are not available at a moment's notice night or day.

Another serious objection is a mistaken diagnosis. The same author admits to five cases, one of them fatal, which might have been saved by immediate operation. It is also admitted that there is some wastage of hospital beds. Appendicectomy is recommended two or three months after the attack has settled down and the patient is asked to sign an agreement to that effect, otherwise there is a real danger that he may escape with his appendix! The wastage of beds cannot be dismissed lightly. Nor can the patient's point of view be disregarded. He has to face the disagreeable return to hospital later and a second absence from work that may mean the loss of a job. Finally, there is the extra strain thrown upon the surgeon and nursing staff. It should be realized that in an average ward there might be three or four of these cases under observation at one time.

I have tried to give a fair account of the expectant treatment and the objections to it. Unfortunately the same cannot be said about descriptions of the immediate operation by advocates of the delayed method. Some of them either amount to an entire misrepresentation of the facts or apply to operators who should be doing something else. Before giving the detailed figures of my own cases I shall, therefore, describe very briefly the principles which have guided me in treatment.

One of the first things to make quite clear is that 'immediate operation' does not necessarily mean a formal appendicectomy. Nothing is more certain than that anatomically and pathologically each case is an individual problem in treatment. The ease with which an appendix can be delivered from the abdomen varies enormously. In an early case, with inflammation limited to the appendix and a mobile cæcum, nothing can be much easier. In a late abscess, with a *congenitally* fixed cæcum and the appendix possibly embedded in the retrocæcal tissues, it may be so difficult that it would be criminal to attempt it.

This is the type of case, in the hands of the inexperienced surgeon determined to remove the appendix at all costs, that has brought discredit on the immediate operation. Not satisfied with gentle separation of recent inflammatory adhesions, he sets about tearing through peritoneal layers that have been there since birth, opening up retroperitoneal cellular tissue to infection. In a mess of blood and pus the inflamed and œdematous cæcum is at last

brought up sufficiently to allow removal of the appendix. If the patient does not die from toxæmia, complications are only too likely to follow.

In the great majority of cases I have employed a muscle-splitting incision (gridiron) at a site determined by the physical signs, i.e., point of maximum tenderness, palpable mass, etc. The paramedian incision is too far removed from the scene of operations, and the Battle incision, in addition to that objection, is liable to damage nerves or to lead to secondary hæmorrhage from the deep epigastric vessels later. Very gentle palpation with one finger in the peritoneal cavity is usually sufficient to determine the type of case one is dealing with.

Table IV.—Mortality of Operation according to Period since Onset.

Day	I Limited to Appendix			II Local Peritonitis			III Diffuse Peritonitis			IV Abscess			Totals		
	R.	D.	Mortality	R.	D.	Mortality	R.	D.	Mortality	R.	D.	Mortality	R.	D.	Mor. tality
			Per cent			Per cent			Per cent			Per cent			Per cent
1	40	0	—	16	1	—	0	0	—	2	1	—	58	2	3·3
2	65	0	—	90	0	—	5	1	—	12	0	—	172	1	0·5
3	29	0	—	69	1	—	1	2	—	14	0	—	113	3	2·6
4	13	0	—	9	1	—	2	0	—	9	0	—	33	1	3·0
5	6	0	—	7	1	—	0	1	—	12	0	—	25	2	7·4
6	7	0	—	1	1	—	2	0	—	8	0	—	18	1	5·3
7	5	0	—	3	0	—	0	0	—	9	0	—	17	0	0·0
8	3	0	—	1	0	—	0	0	—	4	0	—	8	0	0·0
9	1	0	—	0	0	—	0	0	—	0	1	—	1	1	50·0
10+	29	0	—	4	1	—	0	0	—	14	1	—	47	2	4·0
Not stated	42	0	—	2	0	—	0	1	—	1	0	—	45	1	2·1
Total	240	0	0	202	6	2·9	10	5	33	85	3	3·4	537	14	2·5

R = Recovered. D = Died.

The appendix is removed in all cases where the general and local conditions permit of its being done without difficulty or danger; in a case of abscess no attempt is made to separate dense adhesions. In at least two cases I have closed the original wound when I have found a retrocæcal abscess densely fixed in the iliac fossa and drained it extraperitoneally through a separate incision. I submit this as a better alternative than cœliotomy (leaving a tube *down* to the abscess but not opening it) or waiting, as suggested in one text-book, till it reaches the anterior abdominal wall! On

occasion I have utilized the method of 'retrograde' removal, or in other cases the mucous membrane has been shelled out of an appendix buried in the wall of the cæcum.

As often as possible the peritoneal cavity has been closed after gently mopping out small quantities of pus. If the wall of the cæcum is much inflamed or there is a massive infection of the peritoneum, a split rubber tube or tubes is left in. Lumbar or suprapubic drainage is provided as required. In all cases where there is any chance of the abdominal wall having been infected the superficial wound is drained by a rubber dam.

Operating on these lines, a surgeon will not do any harm and he will have the great advantage of knowing exactly what type of appendix he is dealing with. In those cases where he decides not to attempt to remove it he can wait with equanimity for it to 'settle down', secure in the knowledge that there is no danger of perforation of an abscess that is draining freely. In two or three weeks' time he will be able to complete the treatment by an appendicectomy, which will then present no difficulty.

My figures are based on 551 consecutive cases operated upon during the past ten years. For the sake of comparison with *Table I*, I have arranged the figures according to the period since the onset in four groups (*Table IV*).

Apart from the fact that 10 out of the 14 deaths occurred during the first six days, there is nothing significant from that point of view. This is clearly seen in the individual groups—i.e., there is no special relation between the percentage mortality and the period since onset. On the other hand, it in interesting to observe that cases operated upon during the first twenty-four hours give a mortality of 3·3 per cent.

The cases in Group I were all acute or subacute—i.e., definite inflammation was present, ranging from catarrhal inflammation to gangrene of the mucous membrane.

In Group II a large number were completely gangrenous, and in all cases there was a definite localized peritonitis. In many cases the peritonitis occupied the greater part of the right side of the abdomen or the pelvis.

The death-rate in Group III is very high, and unless cases are operated upon earlier, probably will remain so. Of the 5 deaths one patient was aged 6 and two others were over 50 and were moribund on admission.

Group IV is particularly interesting because it shows there is no special danger in operating upon a case of abscess at any period after the onset, in spite of statements to the contrary. *Table V* gives the details of operation in this group.

Table V.—Localized Abscess.

	Cases	Deaths
Appendicectomy and no drainage ..	29	0
Appendicectomy and tube drainage ..	46	2
Drainage only	13	1
	88	3

Table VI shows the tendency to an increase in the number of females, noted during the past few years, and the increase in the mortality at the extremes of age.

Table VI.—Age, Sex, and Mortality.

Age Groups	Male		Female		Total		Mortality
	R.	D.	R.	D.	R.	D.	
							Per cent
0–9	17	1	7	1	24	2	8
10–19	89	3	74	2	163	5	3
20–29	94	2	91	0	185	2	1
30–39	39	0	41	0	80	0	0
40–49	16	2	28	1	44	3	6·8
50 +	16	0	18	2	34	2	6
	279		265		530	14	

Note.—Seven cases age not stated.

Table VII gives the average stay in hospital; as times goes on the tendency is to get patients up earlier, and in the uncomplicated cases the period is now approaching six days rather than nine and a half. In other groups it is probable that one cannot reduce the *average* time very much more, though individual cases may be discharged in considerably less time.

Table VII.—Average Stay in Hospital after Operation.

		Days
Group I.	Limited to appendix	9·5
Group II.	Localized peritonitis	16·5
Group III.	Diffuse peritonitis	36·4
Group IV.	Localized abscess	25·2

On the whole, the immediate post-operative complications have been few. In the earlier cases before I began draining the abdominal wall a considerable number suppurated and sutures were cut in the ward. I am not including these or cases of slight bronchitis. All patients requiring further operative treatment or cases of definite bronchopneumonia are included. Excluding the fatal cases the complications were as shown in *Table VIII.*

Table VIII.—Post-operative Complications.

Group I.—	
(Limited to appendix):—	
Abdominal wall abscess	1
Secondary drainage	1
Strangulated hernia through wound (resection of cæcum, etc., primary operation)	1
Hæmophilia	1
Bronchopneumonia	3
Group II—	
(Local peritonitis):—	
Abdominal wall abscess	1
Secondary drainage	2
Secondary suture of wound	2
Residual abscess (one of these associated with tuberculous gland)	3

Group III—
(Diffuse peritonitis) :—
Abortion and residual abscess 1
Ileus-enterostomy 1

Group IV—
(Local abscess) :—
Abdominal wall abscess 1
Abdominal wall abscess with subphrenic abscess .. 1
Secondary drainage 1
Residual abscess 1
Ileus-enterostomy 1

Total 22

Allowing for the comparatively small number of cases, the figures compare very favourably with any cases treated on delayed lines. The total percentage mortality is small enough to allow of an increase of at least 50 per cent in a larger series and yet remain a reasonable figure.

In order to show that these figures are by no means exceptional for the immediate operation, I have collected the figures from four other papers published recently (*Table IX*) :—

Table IX.

Author	Total	Recovered	Died	Mortality
				Per cent
*Raw (1930)[4]	619	603	16	2·58
Stoney (1932)[7] ..	274	267	7	2·55
†Black (1932)[8] ..	340	326	14	4·10
‡Hawe (1933)[9] ..	250	240	10	4·00
Nuttall	551	537	14	2·54
Totals	2034	1973	61	3·00

* Includes his *acute* cases only. † Includes 53 cases of diffuse peritonitis with 10 deaths.
‡ Includes 86 cases under ten years with 3 deaths, and 20 cases over fifty years with 4 deaths.

It might be objected that these figures cannot be fairly compared with those for the delayed method because they include cases operated upon during the first twenty-four hours. Actually if these cases, a comparatively small number, were deducted, it would not appreciably affect the percentage mortality. In my own cases, as seen in *Table IV*, the advantage would lie with those operated upon *after* the first twenty-four hours.

When the statistics in support of these opposing views are fairly considered ; when it is remembered that many cases fail to subside and that the operative risk is then more than doubled ; that, even if they do, they remain for several days objects of excessive care and anxiety to the nursing and surgical staffs, it is amazing that the expectant treatment has gained so much support.

In view of what has been said, there is in reality no justification for the assumption that the delayed operation is the last word in the treatment of cases of acute appendicitis seen two or three days after the onset. To many surgeons this is a retrograde step, and it is a matter of considerable importance that this should be realized by students and practitioners.

SUMMARY.

1. It is generally admitted that delayed operation is not suitable for children or the aged.

2. The expectant treatment is mainly based on figures which appear to show that operation is particularly dangerous during the period 3rd to 5th day inclusive, and it is suggested that the patient is then in a 'negative phase'.

3. It is shown that if these figures are corrected for age groups, the great majority of the deaths in that period occur in children or the aged. There is no pathological evidence for a 'negative phase' at all.

4. It is claimed that the occurrence of complications is less, and the stay in hospital considerably shorter, with immediate operation.

5. An outline of the expectant routine is given, exposing its serious disadvantages, illustrated in several instances by examples from accounts by advocates of the method.

6. The principles of the immediate operation have been grossly misrepresented in some papers. A brief description of the writer's views is therefore given.

7. This is followed by an analysis of 551 consecutive cases operated upon by the writer with a total mortality of 2·5 per cent.

8. A further series of totals is quoted from four recent papers in order to show that these results are not exceptional.

REFERENCES.

[1] LOVE, R. J. McN., *Brit. Jour. Surg.*, 1922–3, x, 520.
[2] LOVE, R. J. McN., *Ibid.*, 1924–5, xii, 232.
[3] ADAMS, J. E., *Brit. Med. Jour.*, 1925, i, 723.
[4] RAW, S., *Ibid.*, 1930, i, 483.
[5] WILKIE, D. P. D., *Ibid.*, 1931, i, 253.
[6] Roy. Soc. Med. Discussion, *Ibid.*, 1932, ii, 880.
[7] STONEY, R. A., *Ibid.*, 923.
[8] BLACK, J. M., *Ibid.*, 1136.
[9] HAWE, P., *Liverpool Med.-Chir. Jour.*, 1933, i, 89.
[10] RYLE, J. A., *Clinical Jour.*, 1933, Feb., 45.
[11] RAYNER, H. H., *Ibid.*, March, 89.
[12] BROWN, H. H., *Ibid.*, June, 247.
[13] LOVE, R. J. McN., *Lancet*, 1933, i, 1229.
[14] RAMSAY, R. A., *Ibid.*, 1317.
[15] LOVE, R. J. McN., *Ibid.*, 1364.
[16] QUERVAIN, F. de, *Clinical Surgical Diagnosis*, 1926, 416.
[17] OGILVIE, W. H., *Recent Advances in Surgery*, 1928, 289.
[18] BAILEY, HAMILTON, *Emergency Surgery*, 1930, 40.
[19] WAKELEY, C. P. G., and HUNTER, J. B., *Rose and Carless' Surgery*, 1930, 1190.
[20] ROMANIS, W. H. C., and MITCHINER, P. H., *Text-book of Surgery*, 1930, ii, 694.
[21] HOMANS, J., *Text-book of Surgery*, 1931, 963.
[22] MAYBURY, B. C., and WILLIAMS, B. W., *Choyce's System of Surgery*, 1932, ii, 431.

THE PATHOLOGY, DIAGNOSIS, AND TREATMENT OF CONGENITAL DIAPHRAGMATIC HERNIA IN INFANTS.

By N. R. BARRETT,

FIRST ASSISTANT, SURGICAL UNIT, ST. THOMAS'S HOSPITAL;

AND C. E. W. WHEATON,

REGISTRAR, CHILDREN'S DEPARTMENT, ST. THOMAS'S HOSPITAL.

Diaphragmatic hernia can no longer be regarded as a pathological curiosity since more than a thousand cases have been recorded in detail and many hundreds have been subjected to operation. The acquired type of hernia is much more common than the congenital, and in this the general lines of diagnosis and treatment have been studied and agreed upon. The object of this paper is to record two cases of congenital hernia in infants and to remark upon the surgical treatment which is advisable at this period of life.

DEVELOPMENT.

The pleural cavities have been described by Keith as extruded portions of the cœlom, and in the early embryo they communicate freely with the peritoneal cavity. In the adult the muscular sheet of the diaphragm serves to separate the one from the other, and in view of the complexity of its development it is not surprising to find that congenital abnormalities are occasionally present. The ventral part of the diaphragm is formed from the septum transversum, which in the very early embryo is a partition lying between the heart and the abdominal viscera and growing from the splanchnic mesoderm lateral to the foregut. This septum, which derives its nerve-supply from the 3rd and 4th cervical nerves, is at first situated in the neck; as the embryo enlarges, however, it moves caudally, until at the end of the third week it occupies its final position opposite the level of the 12th rib. In this place it is joined by a thickening of the mesodermal cells at the upper end of the dorsal mesentery which bridge the gap posteriorly and fuse with the septum transversum, thus forming a continuous partition between the dorsal and ventral parts. A communication, however, remains for some time between the pleural and peritoneal cavities; it lies in relation to the 12th rib posteriorly on each side and is referred to as the pleuro-peritoneal canal; through this the pleura and peritoneum are continuous as one membrane. At the end of the fourth week the canal is closed by a double fold of serous membrane derived on the thoracic side from the pleura and inferiorly from the peritoneum. A dissection of the diaphragm in the newly born child shows that the site of the pleuro-peritoneal canals is still marked on each side by a sheet of fibrous tissue devoid of muscle fibres. The lateral portions are said to grow from the chest wall. This brief description of the

development of the diaphragm serves to illustrate the embryological significance of the various types of congenital hernia which may be found.

TYPES OF CONGENITAL HERNIA.

The classification quoted here is that of Hume, who has divided congenital hernias into the following groups :—

1. *Hernia through the dome of the diaphragm.* In its mildest form this is not really a hernia at all ; it is merely a bulging of a part of the diaphragm and is known as 'eventration'. In the more advanced cases the state of affairs is different, for here there is an abnormality in the development of the septum transversum and some of the abdominal viscera may be included in the septum ; the condition is nearly always associated with incomplete rotation of the gut, and the prognosis as regards life is poor.

2. *Hernia in relation to the œsophageal opening.* This is probably the commonest of all varieties, and the sequence of events which bring it about has been described by Keith as follows : " The stomach is originally almost cervical in position, but as the pleural diverticula expand and the diaphragm descends the œsophagus becomes elongated and thus the stomach also descends, maintaining its position below the diaphragm. If the œsophagus does not elongate the descent of the stomach is arrested and thus we find it placed within the posterior mediastinum surrounded by its sac of peritoneum. The sac is not formed by the protrusion of the organ but by the downward movement of the diaphragm over the stomach which is stationary." The condition has also been described in detail by Lawford Knaggs, who records the complications associated with it and shows that, although the stomach is often the only part of the intestine to be herniated, the colon, spleen, pancreas, and liver are commonly present as well.

3. *Complete absence of one or both halves of the diaphragm, allowing the peritoneum to communicate freely with the pleural cavities.* This type of hernia is incompatible with life in the majority of cases, although one patient is described as having lived till the age of 17.

4. *Hernia through the pleuro-peritoneal canal on one or other side.* The cases about to be described are instances of this type. The hernial orifice is present much more frequently on the left side than on the right and is situated in the extreme posterior part of the diaphragm in front of the 12th rib and immediately above the kidney and suprarenal body. The deficiency is usually much larger on the left than on the right where the diaphragm is supported by the mass of the liver.

5. *Hernia through one of the vascular or nervous foramina.* The commonest is perhaps the hernia in relation to the superior epigastric vessels, although on rare occasions a gap has been found in relation to the 7th costal cartilage. The developmental significance of the latter is not known.

PATHOLOGY.

It is interesting to note that the incidence of the different types of hernia varies considerably in the series reported by Hume and that reported by Keith, for in 35 cases investigated by the former there was only 1 hernia

through the pleuro-peritoneal canal, whereas in the 34 cases reported by Keith there were no fewer than 21 of this type. The explanation presumably lies in the fact that the cases collected by Keith were taken from the various London museums, whereas the other series represents an analysis of clinical material. Nevertheless the figures of Keith emphasize the fact that cases of hernia through the pleuro-peritoneal canal are not as rare as might be expected, and further that some of these live long enough to make surgical repair a possibility; indeed, he concludes his paper by saying that "from an examination of these figures I am of the opinion that a considerable number of these cases might be successfully operated upon if the condition were recognized at the time of birth." As regards this particular type of hernia, the figures he quotes are as follows:—

Hernia through the pleuro-peritoneal canal on the left side (17 cases)	12 died at or before birth 1 lived six hours 1 lived six weeks 1 lived three months 1 lived thirty-four years 1 lived to old age
Hernia through the pleuro-peritoneal canal on the right side (4 cases)	2 died at or before birth 2 died a few hours after birth

Further, the fact that active treatment is needed in selected cases is shown by the work of Hedblom, who found that in a series of 210 cases of congenital hernia under the age of one 75 per cent died before the end of the first month.

In those patients who survive, the onset of symptoms is usually associated with the development of intestinal obstruction. It is a matter for dispute at what stage the intestines pass into the thorax, and although it is probable that this event occurs during intra-uterine life, there are undoubtedly instances in which it occurs shortly before the onset of acute symptoms. The case recorded by Barford is an illustration of this. He attended the birth of a child which at first appeared to be normal in every way and breathed strongly. After twenty-four hours the respirations began to be laboured and the child was cyanosed. It died shortly afterwards, and at the autopsy a diaphragmatic hernia was discovered, the orifice being in the position of the pleuro-peritoneal canal; the thorax was filled with intestines. An examination of the lungs showed that both sides had expanded normally but that the left lung was compressed and airless. This suggests that at birth very little, if any, of the intestines had passed through the orifice, but that as the child cried and breathed, the coils were sucked into the thorax until the pressure upon the lungs was such that life was no longer possible.

Once the intestines have passed into the thorax the negative pressure tends to prevent or hinder spontaneous reduction such as might occur under the influence of gravity. In a number of cases, however, the amount of bowel which has herniated is not in itself sufficient to influence the workings of the chest. X-ray photographs have often shown that the mediastinum and heart may be displaced to the other side of the chest without any alarming results. The trouble begins for the patient when, owing to an overloaded bowel or tightness of the hernial orifice, which presumably does not increase much in size as the infant grows, a state of gradually increasing distension

of the gut occurs. This distension is followed by an upset in the peristalsis of the herniated bowel and paralytic ileus ensues. Owing to the absence of adhesions which is characteristic of congenital hernia here as elsewhere, strangulation is a late result, and in the average case there are several days in which the paralytic ileus is gradually developing, during which a diagnosis and treatment may be attempted; a longer delay leads to an increase of intrathoracic pressure which impedes the action of the heart and lungs and results in gangrene of the bowel.

Even in patients who have safely survived the early years of life adhesions in the thorax are very slow to form, and a review of the literature shows that when present they are most likely to involve the omentum as it passes through the orifice. In the terminal stages of the condition, and particularly where strangulation has occurred, a pleural effusion may develop.

Finally, the condition of the bowel within the abdomen must be remembered, for the afferent loop, be it stomach or intestine, may be in a more dangerous state than the herniated bowel.

The cases which have been recorded show that it is most unusual for other congenital deformities, apart from mal-rotation of the gut, to be present as complicating factors.

DIAGNOSIS.

Bradley, quoting figures from the Mayo Clinic, gives the frequency of congenital hernia as 1 in 18,000 admissions, and, from a review of this and other literature, states that it is twelve times as common on the left side as on the right. It is well known that there may be no signs of hernia during childhood, and cases such as that of Lewald show that it is even compatible with active physical exercise. Lewald's patient actually won a five-mile race. The cases, however, to which we particularly refer are those showing few physical signs at birth, but developing more serious manifestations during early infancy. There is no doubt that in many the diagnosis is extremely difficult, and Truesdale has remarked that it is more difficult than operative cure.

The cases are most commonly mistaken for congenital heart disease, in that the state presented in left-sided hernia is one of dextrocardia with attacks of cyanosis and dyspnœa. In others the sudden onset of cyanosis and loss of consciousness has presented the appearance of a cerebral hæmorrhage or pneumonia, while in the third group, when vomiting has been the predominant sign, a diagnosis of gastro-enteritis has been made.

It is therefore impossible to make a diagnosis from the history alone, but once the hernia has begun to make itself felt the symptoms are usually progressive, and repeated examinations of the thorax and abdomen will eventually establish the true state of affairs, especially in cases of hernia through the pleuro-peritoneal canal, where it is usual for a considerable amount of the abdominal contents to pass into the thorax. In this type of case Jewesbury is of the opinion that diagnosis should not be difficult.

The cardinal signs are displacement of the heart and mediastinum, associated with evidence of the presence of bowel in the thoracic cavity. The

latter should be fairly easy to detect on repeated examination, for bowel sounds will be heard in the thorax, whilst absence of intestines in the abdominal cavity will be suggested by the scaphoid outline of the abdominal wall. It remains to be said that any suspicious case should be completely investigated by radiological methods.

CASE REPORTS.

Case 1.—A male child aged 3½ months, the second child of healthy parents—another child, 4 years old, being well—was brought to hospital on account of dyspnœa since birth.

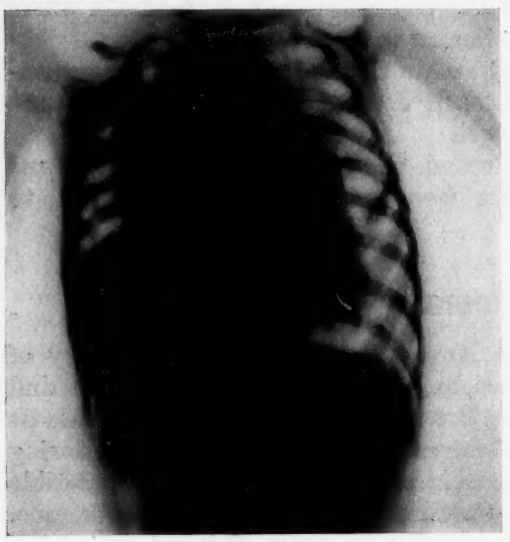


FIG. 288.

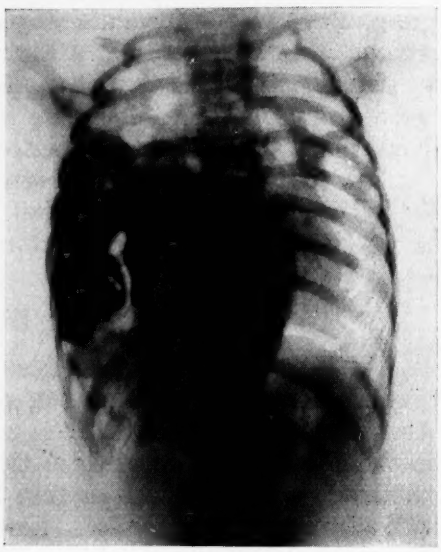


FIG. 289.

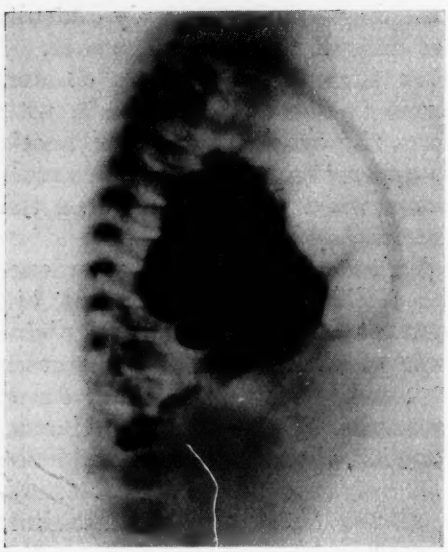


FIG. 290.

FIG. 288.—*Case* 1. X-ray of the thorax and abdomen showing the thorax to be full of gas shadows on the right side.

FIG. 289.—*Case* 1. Antero-posterior view, after a barium meal, showing that the right side of the chest is full of distended bowel.

FIG. 290.—*Case* 1. Lateral view after a barium meal, showing the position of the hernial orifice to be in the region of the pleuro-peritoneal canal.

The labour had been at full term and the birth weight was 8½ lb. The child had been breast-fed for nine weeks and after that had been given Nestlé's milk, Peptolax, and finally a Cow and Gate mixture, the changes being made on account of the slow gain in weight. At birth a mild generalized cyanosis had been noted; but, although the feet and hands had occasionally been blue, there had been no definite cyanotic attacks. The only symptoms which the parents had noticed were continuous dyspnœa and rapid respirations.

On Examination (*Figs.* 288–290).—Temperature 98°, pulse 160, respirations 56, weight 10 lb. 7 oz. A thin cheerful child with slightly laboured and rapid respirations. Chest: movements equal on both sides; some impairment of percussion note on the right side, especially at the back. No breath-sounds were audible over the lower part of the right side of the chest posteriorly, and there were no adventitious sounds. Vocal resonance absent at the right base. Air entry poor on the right side at the apex. Heart: normal. Apex beat ½ in. to the left of the left nipple line. Abdomen: concave. Respiratory movements exaggerated.

At a later examination intestinal sounds were clearly heard over the right side of the chest. Further, it was noticed that there were two types of dyspnœa, the first occurring towards the end of a large feed, when the child became pale and collapsed and the pulse was extremely poor; the second occurring about twenty minutes after a small feed, when similar signs developed.

An X-ray examination after a barium meal had been taken showed that the small bowel had passed up behind the liver through a deficiency at the back of the diaphragm. The right side of the thorax was completely filled.

It was concluded at the time that in view of the serious general state of the child no operative treatment would be of any value and it was sent home, where it died a few weeks later. No post-mortem was available. If operation had been undertaken, it might have been possible to reduce the herniated bowel by traction from below, and if the liver could not have been fixed over the orifice, this could then have been closed by a limited thoracotomy. In view, however, of the end-result, we feel that operation should have been tried.

Case 2.—A child aged 4½ months, the only child of healthy parents. At birth the weight was 8½ lb. and progress had been normal until fourteen days before admission to hospital, when occasional vomiting had started. A letter from the doctor states that about one week before admission he had treated the child for an attack of gastro-enteritis. This cleared up quite rapidly, but it was during this time that the first attack of cyanosis was noticed. The parents had also noticed that the baby was very constipated. It was brought to hospital as a case of dextrocardia.

On Examination.—Temperature 96°, pulse 150, respirations 40, weight 10 lb. 7 oz. Chest: impaired movement and impaired percussion note with absent air entry anteriorly on the left side; hyper-resonant note at the left base posteriorly; on one occasion intestinal sounds were heard over the upper part of the left chest. Heart: the cardiac impulse was prominent below the right costal margin, and percussion showed that the left border was at the right edge of the sternum. The heart-sounds were normal. Abdomen: the abdominal wall was retracted, but no other abnormality was found. A diagnosis of diaphragmatic hernia was made in the Out-patient Department on these physical signs.

The child took his feeds well—6 fluid ounces of Cow and Gate mixture four-hourly, although he usually had difficulty in finishing a meal; about ninety minutes to two hours later he became cyanosed and extremely distressed and the respiratory rate increased from a normal 40 to 50 to about 80 per minute. X-ray examination before and after a barium meal showed that the left side of the chest was filled with bowel, chiefly small intestine. (*Figs.* 291, 292.)

April 28, 1933.—The general condition of the child was becoming steadily worse; there was a progressive loss of weight and the attacks of cyanosis were frequent and prolonged. It was therefore decided that the only chance of saving the life of the child was by operation. It was given a course of subcutaneous saline and the stomach was washed out just before it was taken to the operating theatre.

First Operation (Mr. Max Page).—Anæsthetic (Dr. Mennell): open ether. A left paramedian incision extending from the costal margin to the umbilicus was made. The abdomen appeared practically empty and all the intestines except the stomach had passed into the thorax. The spleen was still in the abdomen. The

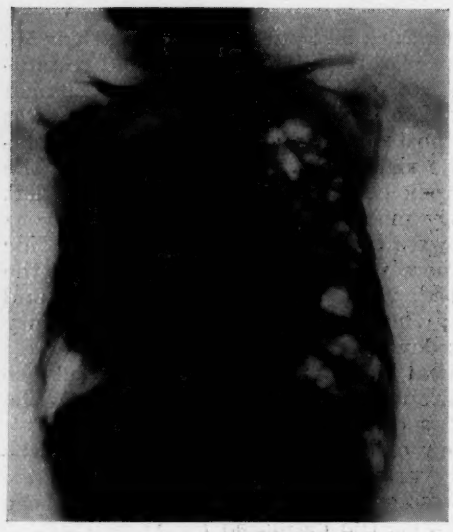


Fig. 291.—*Case* 2. X-ray photograph taken before operation showing the left side of the chest to be full of gas shadows, and the heart displaced completely over to the right.

Fig. 292.—*Case* 2. X-ray photograph after a barium meal. The majority of the intestines are in the thorax and the orifice is on the left side of the diaphragm.

Fig. 293.—*Case* 2. X-ray photograph —taken after operation—immediately after a barium meal, showing the hernia to have been reduced and the chest free from gas shadows. The heart has already moved to the left.

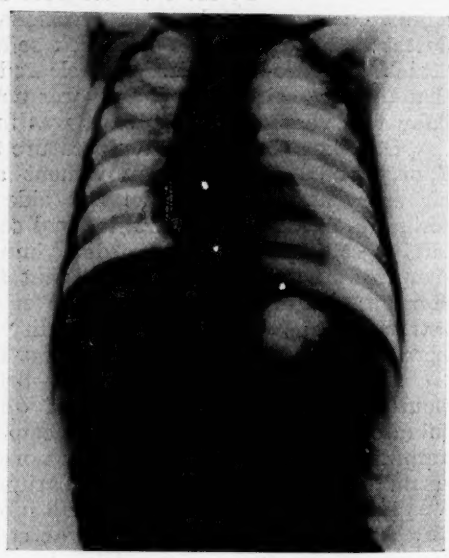


Fig. 294.—*Case* 2. Showing the state of affairs one hour after that shown in *Fig.* 293. The heart and mediastinum have almost returned to the normal position.

herniated bowel was replaced by gentle traction from below, first the small intestine, then the ileocæcal region, and finally the ascending and transverse colon were reduced from the thorax. These were packed off so that the orifice in the region of the left pleuro-peritoneal canal was easily seen: four stitches of chromic gut were used to suture the fascia on the upper part of the kidney to the anterior lip of the orifice; the abdomen was closed in layers. During the course of the operation the condition of the child improved enormously immediately the intestines had been withdrawn from the thorax. On returning to the ward the general state was good

FIG. 295.—*Case* 2. Photograph of the left half of the diaphragm from above. The pericardium with the phrenic nerve running across it can be seen anteriorly; in the middle is the lower end of the œsophagus, and posteriorly the hernial orifice. The closing sutures have been taken out.

and the child was fed with small quantities of a milk from a spoon. Later on the feeds were gradually increased till he was having eight three-hourly feeds daily. There were no further attacks of cyanosis.

SUBSEQUENT PROGRESS.—

April 30, 1933.—The bowels were open normally.

May 2.—An X-ray photograph was taken which showed that the diaphragmatic hernia had been completely reduced. (*Figs.* 293, 294.)

May 6.—Breath-sounds were heard over the upper part of the left chest, and the left border of the heart had moved to a point 1 in. internal to the left nipple line. A

further barium examination was made and was reported upon as follows: "No evidence of any hernia into the chest; bowel function normal."

May 7.—The child's condition was not so good; he was fretful and had vomited.

May 8.—Vomiting had become frequent and was associated with abdominal distension. Marked peristalsis could be seen. The increased intra-abdominal pressure had caused a large left inguinal hernia to appear. It was thought that this might account for the distension by causing some degree of obstruction, but the hernia was easily reducible and could be controlled by a woollen truss.

May 9.—General condition worse; absolute constipation for two days. A diagnosis of intestinal obstruction was made.

Second Operation (N. R. B.).—Anæsthetic: open ether. A small muscle-splitting incision was made in the right iliac fossa. Large distended coils of small bowel presented and a blind ileostomy was performed. A large amount of intestinal contents were immediately evacuated. After the operation the ileostomy functioned well, but the child became progressively weaker and died on May 16.

Autopsy.—At the post-mortem examination it was found that the orifice in the diaphragm had been successfully closed and that healing was well advanced. (*Fig.* 295.) The mobility of the intestines, however, was such that a portion of the small bowel at the lower end of the ileum had undergone rotation about an adhesion which had formed in the left upper quadrant of the abdomen and a length of about 2 in. had become gangrenous. From this segment of the intestine an infection had occurred and signs of early spreading peritonitis were apparent. The ileocæcal region was still lying in the neighbourhood of the closed hernial orifice. The ileostomy had relieved the distension above the obstruction.

In the thorax the heart had moved over to the left side, and the left lung had expanded almost to a normal degree. There was no pleural effusion. No other congenital abnormalities were found.

TREATMENT.

In the past congenital diaphragmatic hernia has been regarded as a hopeless surgical proposition and treatment has been palliative. Indeed Hume concludes that "surgical treatment is unlikely to be required for hernia through the hiatus pleuro-peritonealis. In those cases that survive more than a few days the opening is large enough to prevent obstruction. Under certain circumstances such a condition might demand a herniotomy, but no attempt would be made to transfer the intestines to the abdominal cavity." It is now generally agreed, however, that an infant showing signs and symptoms referable to a diaphragmatic hernia can sometimes be cured if active surgical measures are possible. From a study of the various types of hernia which occur it will be apparent that some are hopeless from the beginning —for instance, a large defect cannot possibly be closed, whilst a hernia on the right side will be much more difficult to approach and reduce than a corresponding condition on the left. In the case, however, of a hernia through the pleuro-peritoneal canal on the left side, or the œsophageal opening, there is a good chance of success, and an attempt to repair the defect must certainly be made as soon as the diagnosis is established.

It will be apparent that an exact knowledge of the position of the hernial orifice will be necessary before any operation is decided upon, for on this knowledge the type of treatment depends and the relative chances of success are based. The information can be obtained in most cases from a series of X-ray photographs taken after the child has swallowed a barium emulsion. A lateral view is often helpful in deciding the position of the hernia with

reference to the front or back of the diaphragm. The improvements in diagnosis which have resulted from the use of X-rays have been clearly shown by Greenwald and Steiner.

Unfortunately it is difficult to form an idea of the size of the hernial orifice from an X-ray photograph, for it has been repeatedly shown that the amount of intestine which has passed through bears no relation to the lumen of the aperture, and this is not really surprising when it is remembered that the spleen, pancreas, or liver may have lodged in the fairway as well. It is, however, reasonable to surmise that a hernia through a patent pleuro-peritoneal canal will have a small orifice, another through the lateral sector in the vicinity of the 7th costal cartilage a slightly larger one, and those through the dome of the diaphragm a larger deficiency still. It is impossible to estimate the extent of the œsophageal herniæ.

The pessimism as to results of surgical attack upon these herniæ occurring in infants was based upon the fact that very few cases had been subjected to operation and the methods which had been found of value in traumatic and adult cases were used without success. In the last ten years, however, a considerable number of babies have been operated upon and the results have been duly recorded, so that it is possible to form an opinion about the relative merits of the various techniques which have been advocated by different surgeons.

It must be emphasized at the outset that the problem is quite different in infants and in those who survive childhood without symptoms, for in the latter the state of acute emergency has seldom been reached, a set operation can be planned, and the whole course of treatment worked out according to schedule. Further, the size of the affected parts and their relative strength and mobility are considerably changed as the patient grows older, so that a method of approach which is suitable for the one will be of no avail for the other.

The surgeons who have contributed most to our knowledge of treatment of these herniæ in the adult are Hedblom and Truesdale. The former has recorded a series of over 1000 cases of diaphragmatic hernia of all kinds, in which operation was carried out in nearly 400; it is significant, however, that in this enormous series he mentions only 6 cases under the age of 5, which had been reported before 1924. Since this time a fair number of operations have been successfully done in infants, and the results of the treatment in some will be referred to and criticized.

Pre-operative Treatment. — As regards pre-operative treatment, it is important to improve the general condition of the patient as much as possible, and this can be achieved to some extent by subcutaneous, intravenous, or rectal salines; again, it is essential that the stomach be emptied by washing it out before the operation starts, for it will probably be dilated and may be full of fluid. In the case which was operated upon by Leopold the stomach was greatly distended with fluid, which not only made the approach to the hernial orifice difficult, but played an important part in the death of the child, for during the manipulations necessary to reduce the hernia the contents of the stomach regurgitated into the pharynx and caused asphyxia, so that the operation had to be temporarily abandoned, and the child eventually died

of shock, although the defect in relation to the œsophagus had been successfully repaired.

Anæsthesia.—It would appear that the anæsthetic of choice has not yet been found, for almost all the surgeons about to be referred to have selected a different method. It has been shown that a sac is present in less than a quarter of the cases of congenital hernia, and therefore in the majority a pneumothorax will be produced whether the abdominal or the thoracic approach is chosen. This has led to the use of positive-pressure anæsthesia, and Truesdale attributes his successes to a large extent to this fact. On the other hand, it has been pointed out that if a laparotomy is done, the pneumothorax will not be a serious matter, for the lung and mediastinum on the affected side are already displaced and the size of the hernial orifice is not as large in a favourable case as the wound made by thoracotomy. At the other extreme is a local anæsthetic such as was employed in the operation successfully accomplished by Iizuka and Sano, but the time taken in administering the anæsthetic and in keeping the child still must be considerable and must add to the risk of an already serious procedure. There remains to be considered the use of open ether, and to the writers this appears to be best. It is certainly an anæsthetic which can be tolerated with reasonable safety by infants in a dehydrated state, a fact which has been well shown in the cases of congenital pyloric stenosis which have been operated upon by Max Page with such good results. It would not, however, be suitable for an extensive thoracotomy.

Method of Approach.—The method of approach is a much debated point, and before discussing the relative merits of laparotomy and thoracotomy it is well to point out certain statistics. In the first place the general mortality of all cases which have been operated upon, according to one authority, is 54·5 per cent, whereas in infants it rises to 80 per cent. In the absence of the signs of intestinal obstruction the mortality for all cases is as low as 23·8 per cent. These figures show clearly that the advice which used to be given—namely, do not operate unless in the presence of obstruction or thoracic compression—is responsible to a great extent for the high death-rate, and we consider that every case in which a reasonable chance of success is present should be dealt with as soon as the diagnosis is made.

Thoracotomy.—The advocates of thoracotomy as a method of approach maintain that the exposure obtained by spreading the ribs is very much better than that by laparotomy, and this is especially true in the herniæ through the pleuro-peritoneal canal and the lateral part of the septum, which, after all, are the most amenable to treatment. In addition to this, once the hernia has been reduced, it is much easier to close the hole from above than from below, for not only is the field free from the coils of distended intestine, but if any difficulty is experienced in bringing the edges together, the phrenic nerve, which is lying close by upon the pericardium, can be put out of action and the corresponding half of the diaphragm relaxed. If it is still difficult to close the orifice, the lower two ribs can easily be severed, a method which was used by Bettman and Hess in the operation successfully performed by them.

Laparotomy.—In spite of these advantages, the safest and best approach in infants is by laparotomy. In the first place those cases in which a hernial

sac is present, as is often the case in the œsophageal variety, will not suffer the additional embarrassment of a pneumothorax however small this may be. Then again the general advice of Hedblom may be taken to refer to this particular type; he writes: "Laparotomy and not thoracotomy irrespective of the comparative mortality of each is indicated in all cases in which obstruction is present, because the state of affairs cannot be accurately diagnosed until it has been seen, and because the patient's best chance of recovery may lie in a drainage of the afferent loop." In these infants, who cannot describe or complain of their symptoms, it is almost certain that by the time a diagnosis is made some degree of paralytic ileus or obstruction will be present. Even the advocates of the thoracic approach are agreed on this point, for Truesdale has reported a case in which he did a cæcostomy to overcome the acute obstruction within the abdomen and shortly afterwards repaired the hernia by thoracotomy. Apart from the signs of obstruction, however, there are many in which the correct diagnosis is not made until the abdomen has been opened; for instance, Towers has reported a case which was diagnosed as an acute intussusception, a mass being palpable in the left upper quadrant of the abdomen. Laparotomy was undertaken and the spleen was found to have undergone torsion; when this had been reduced a diaphragmatic hernia was seen through the posterior quadrant of the left side of the diaphragm. As there were no signs of obstruction at the time, the repair of the hernia was deferred and was successfully completed at a second laparotomy later on when the child had recovered from the first operation.

Reduction of the Hernia.—Finally, the question of the actual reduction of the hernia is of the greatest importance. These cases are characterized by the large amount of bowel which herniates, all of which must be handled during the process of reduction, and the shock to the patient is considerable. It is therefore a fact of great importance that, whereas it is an easy matter to pull the intestines through the orifice from the abdominal side, it is practically impossible to push them through from the thorax. In addition to this, if any of the viscera have passed through as well, the orifice may be completely occluded. This difficulty was encountered by Coryllos and Tow, who have recorded the case of a baby 13 days old in which they were able to repair the opening. The child, which was apparently normal at birth, remained well until the seventh day, when it developed a sudden severe attack of cyanosis and dyspnœa. Radiography showed a hernia through the left pleuro-peritoneal canal and operation was advised. The hernial orifice was approached by thoracotomy and the chest was found to be full of distended intestines. There were no adhesions, but reduction of the hernia was impossible because the spleen had passed through and was held firmly against the orifice by its mesentery. The thoracic incision was therefore prolonged on to the abdomen to the left of the mid-line, and reduction of the spleen and intestines was easily effected from below. The operation took forty-five minutes in all. In spite of the severity of this, the patient survived, which reminds one how much a very young baby can resist, and it would appear that not only can they resist anoxæmia to an extraordinary degree but that the heart is very strong at this age. The same difficulty of reducing the hernia from above

was experienced by Bettman and Hess in the case already mentioned, and they were forced to do a laparotomy as well. It is of interest that the hernia with which they were dealing was of the type in which the defect is laterally placed opposite the 7th costal cartilage. It has been suggested that the difficulty can be overcome by stretching the orifice manually or by extending it in a lateral direction, but even this has proved unsuccessful and must be considered a destructive procedure when the whole thing can be done from below without difficulty. Further, if by any remote chance some adhesions had already formed and were preventing reduction, a thoracotomy can still be done as a secondary measure.

It might be argued that the method of choice is a combined laparotomy and thoracotomy, but there is no doubt that in infants this should be avoided if possible. From a study of the operative mortality in older cases it is apparent that the combined operation is consistently associated with a higher mortality than either of the other two done separately. It has already been pointed out that the mortality in these infants is high in any case, and to attempt the double event when the whole procedure can be done by laparotomy alone is to make the operation an altogether more serious business. There have been a number of instances in which success has been achieved from below, and the surgeons who report these cases lay stress on the fact that the operation has not been difficult. The cases described by Schönbauer and Warkany, Donovan, McCleave, Iizuka and Sano, and Leopold should be particularly consulted. From the anatomy of the part it will be seen that the orifice of a hernia through the left pleuro-peritoneal canal can be easily closed by suturing the fascia which lies on the front and superior aspect of the kidney and suprarenal body to the peritoneum on the anterior part of the orifice. This fascia is well suited to bridge the gap because it is strong and at the same time fairly mobile on the front of the kidney.

Another practical difficulty which arises is that the distended intestines which have been reduced from the thorax may be too large to fit into the abdomen. This can be overcome by pricking the gut in several places and allowing the gas to escape, the points of puncture being invaginated in the ordinary way.

It has been noticed in several of the cases that the general condition of the patient improved as soon as the intestines had been withdrawn from the thorax; this was due to the reduction of the intrathoracic pressure and also to the fact that the compressed lung had to some extent become operative. This advantage should be pressed home at the conclusion of the operation and the child should be given CO_2 to breathe; if an intratracheal or positive-pressure anæsthetic has been used, the lung can be actively expanded. Further, by passing a pneumothorax needle into the pleural cavity on the affected side the pneumothorax can be reduced to a minimum by slowly sucking out the air. This procedure has been done successfully on several occasions, and it has been shown that the absence of adhesions allows the heart and mediastinum to move across to their normal position almost immediately. If the pneumothorax is not removed in this way, the absorption of the air takes about fourteen days, a fact which has been demonstrated by subsequent X-ray photographs.

SUMMARY.

1. A certain number of cases of congenital diaphragmatic hernia occurring in infants can be cured by surgical intervention.

2. The most favourable types are those through the pleuro-peritoneal canal on the left side, lateral defects in the septum, and small herniæ in relation to the œsophagus.

3. Laparotomy rather than thoracotomy is the method of choice.

4. Open ether is the best anæsthetic.

5. The hernia can be easily reduced from below, but only with extreme difficulty from above.

6. The operation if done from below is not difficult in favourable cases.

7. Adhesions are very rarely present and need not be anticipated.

8. The pneumothorax should be removed at the conclusion of the operation.

Our thanks are due to Dr. R. C. Jewesbury and Mr. Max Page for advice and criticism and for permission to publish these cases, which were under their care. Dr. Fildes has kindly supplied the X-ray photographs.

REFERENCES.

HUME, J. B., *Brit. Jour. Surg.*, 1922, x, 207.
KEITH, Sir ARTHUR, *Ibid.*, 1924, xi, 455.
KNAGGS, R. LAWFORD, *Lancet*, 1904, ii, 358.
KEITH, Sir ARTHUR, *Brit. Med. Jour.*, 1910, ii, 1297.
HEDBLOM, C. A., *Trans. Amer. Surg. Assoc.*, 1931, xlix, 448.
BARFORD, L. J., *Brit. Med. Jour.*, 1932, ii, 794.
BRADLEY, W. N., *Arch. of Pediatrics*, 1930, xlvii, 384.
LEWALD, *Amer. Jour. Roent. Sci.*, 1925, 13.
TRUESDALE, P. E., *Trans. Amer. Surg. Assoc.*, 1931, xlix, 114.
GREENWALD, H. M., and STEINER, M., *Amer. Jour. Dis. Child.*, 1929, xxxviii, 361.
LEOPOLD, J. S., *Ibid.*, 1927, xxxiii, 597.
IIZUKA, T., and SANO, V., *Orient. Jour. Dis. Infants*, 1932, xi, 23.
BETTMAN, R. B., and HESS, J. H., *Jour. Amer. Med. Assoc.*, 1929, xcii, 2014.
TOWERS, R. J., *Brit. Jour. Surg.*, 1927, xv, 332.
CORYLLOS, P. N., and TOW, A., *Jour. Thoracic Surg.*, 1932, ii, 56.
SCHONBAUER, L., and WARKANY, J., *Zeits. f. Kinderheilk.*, 1930, l, 125.
DONOVAN, E. J., *Surg. Clin. N. Amer.*, 1931, xi, 521.
McCLEAVE, T. C., *Amer. Jour. Dis. Child.*, 1917, xiii, 252.

PROSTATECTOMY WITH CLOSURE: FIVE YEARS' EXPERIENCE.

By S. HARRY HARRIS,

HONORARY UROLOGIST, LEWISHAM HOSPITAL, SYDNEY.

THE evolution of the operation of suprapubic prostatectomy with complete closure of the bladder has, in the author's hands, been a gradual process from the first stage—i.e., the re-formation of the floor of the prostatic urethra—which was described by him at the second session of the Australasian Medical Congress (British Medical Association) in Dunedin, New Zealand, on March 26, 1927.[1] In its completed form it has been practised by him, with minor variations, in both one- and two-stage operations for upwards of five years dating from October, 1927. The prostatectomy operations for simple hypertrophy performed by the author during the five-year period to October, 1932, are shown in the table below.

SUMMARY OF CASES SUBMITTED TO OPERATION FOR SIMPLE HYPERTROPHY DURING THE FIVE-YEAR PERIOD TO OCTOBER, 1932*.

TYPE OF OPERATION	NO. OF CASES	TOTALS
One-stage prostatectomy	322	371
Two-stage prostatectomy	49	
Deaths 10 = mortality rate 2·7 per cent		
Prostatectomy with closure	356	371
Prostatectomy with suprapubic drainage ..	15	
Reasons for drainage: Two-stage operation (1st stage elsewhere in 5), incomplete technique, 7 cases; urethral calibre too small to admit catheter, 5 cases; presence of foul diverticulum, with plastic on stoma, 2 cases; profuse urethritis, 1 case		
Preliminary cystostomy:—		
Died within one month	5	61
Later prostatectomy	49	
Left as permanent cystostomy ..	7	

Since the last paper,[2] presented before the American College of Surgeons on Oct. 14, 1929, re-opening of the bladder during convalescence has had to be carried out in 3 of 261 patients (1·11 per cent). Of these, one had incomplete drainage due to a faulty catheter and required cystostomy on the seventh

* In the seven-month period from October, 1932, when this paper was completed, to May, 1933 (this period having been occasioned by delays in transit), 42 additional cases have been submitted to the operation with 1 death, making the total number of deaths for the series 11 and the mortality rate slightly lower than 2·7 per cent.

day; one had a severe reactionary hæmorrhage immediately after operation, for which cystostomy and blood transfusion were carried out, followed by complete recovery; and in the third patient the tip of the catheter had found its way through the bladder incision, and, although his urine was free of blood and no urinary extravasation had taken place, there was a considerable amount of suprapubic tenderness and œdema, and on the seventh post-operative day the suprapubic wound was re-opened, the catheter readjusted, and the prevesical space drained—this was followed by complete recovery.

Deaths.—The number of deaths, as stated above, was 10, the causes of which were: Inanition, 47th day, one case; pneumonia, 6th day, two cases; acute intestinal obstruction, 14th day, from carcinoma of the sigmoid, one case; paralytic ileus, 12 and 14 days after spinal anæsthesia, two cases; polycythæmia, pulmonary embolism, 7th day, one case; auricular fibrillation and cardiac dilatation, 4th day, one case; shock, prostatectomy plus deep diathermy to infiltrating carcinoma of bladder base, death 12 hours after operation, one case; panophthalmitis, excision of eye, death 3 days later and 15 days after prostatectomy, one case. This last patient had had a preliminary cystostomy six weeks before the prostatectomy. There had been a number of small pustules below the fistula which were slow to heal. These were in the line of the prostatectomy incision. The day before operation they were touched with pure carbolic acid, and the area of skin containing them was excised during the skin incision. His wound broke down and he developed a general pyæmia. This is a valuable example of the inadvisability of ever carrying out a prostatectomy until all conditions are as reasonably favourable as they can be made.

REPORTS OF PROGRESS.

Papers recording progress of the operation in the author's hands have appeared at intervals during the past five years.[2-4] A moving picture film of the operation was shown before the Annual Congress of the American College of Surgeons in Chicago in October, 1929. In September of that year, through the courtesy of Dr. Joseph F. McCarthy, an operative demonstration of the actual operation was given at the Post-graduate Hospital, New York, before a representative gathering of urologists.

The operation, which is slowly but surely gaining adherents both at home and abroad, is not an operation for the occasional prostatectomist, but will, the author believes, become much more widely adopted when the comparative simplicity of the various steps and the safety and soundness of the surgical principles involved become more widely appreciated.

It will be the object of this paper to present the consecutive steps of the operation in as concise and clear a way as possible; to describe the minor, though important, alterations in surgical technique which have been made since the last publication; and to detail the precautions which the author, in his practice, has found to be essential to the successful issue of any considerable consecutive series of cases where this technique is used.

The particular features of the operation which most commentators appear to miss are, briefly: (1) The complete and immediate control of

hæmorrhage by suture; (2) The plastic covering of all the raw surfaces in such a way that the prostatic urethra is in the great part re-formed and the prostatic cavity obliterated, with the result that healing takes place generally by first intention, septic complications are remarkable for their rarity, fistula formation does not occur, and post-operative recurrence of obstruction is completely obviated.

Notwithstanding 'armchair' criticism concerning the permanency of the plastic portion of the operation on the prostatic bed, extended experience, both cystoscopic and urethrographic, has proved quite definitely that the parts do remain in the position in which they are sewn at the operation. If other than ocular evidence be needed, it is to be found in the fact that when the plastic reconstruction of the floor of the prostatic urethra has been omitted, post-operative recurrence of obstruction has been a not uncommon sequel, while it has proved to be entirely absent in those cases in which this reconstruction has been carried out.

Almost without exception, surgeons who have adversely criticized this operation either have no first-hand knowledge of it, have not followed the technique in anything like its entirety, or have made such alterations as to render it unrecognizable.

There have, as with all new procedures, been several suggested modifications of the original, but so far as the author is able to judge, none so nearly as the original reproduces the normal anatomical and physiological relationship; practically all result in the immediate formation of some type of diaphragm fitting tightly round the catheter; and none seems likely to be so free from annoying post-operative complications as the original has proved to be.

The author would appeal to all who purpose doing this operation to follow the technique in its entirety. Many minor variations have been 'tried out' by him and discarded, and the technique finally adopted has not only been evolved as the result of extended experience, but has stood the test of time. More particularly would he deprecate minor alterations in surgical technique so far as the prostatic cavity is concerned. The reconstruction of the floor of the prostatic urethra is the one vital point, or keystone, upon which a successful plastic operation of this type must be constructed. A complete, clean enucleation of the prostate is, of course, the indispensable foundation.

The results obtainable by this operation, so far as mortality and morbidity are concerned, present a marked contrast to those obtained by some other widely practised 'open' methods, as for example that of Judd and Hunt of the Mayo Clinic, or that of Thomson-Walker as described by Swift Joly and Kenneth M. Walker.[5] Swift Joly, after making a brief and inaccurate reference to the author's operation, describes some of his own attempts to "reduce the size of the raw area in the prostatic cavity", records his failures, and adds: "The prostatic cavity always becomes infected and is unsuited for plastic operations". As a matter of actual fact, where the author's operation more or less completely covers up the raw surfaces, thus guarding them from infection and limiting absorption to the minimum, the Thomson-Walker operation, as described by Swift Joly, not only leaves the entire prostatic cavity wide open for infection and absorption, but makes it

even wider by cutting out a deep V from the apex of the trigone, thus deliberately exposing to even further infection the most vulnerable portion of the urinary tract. Is it any wonder that septic manifestations are common? This last-named step is undertaken with the avowed object of preventing post-operative recurrence of obstruction. According to the admissions of its sponsors it fails in many cases even to do this, and extensive re-operations have to be performed for the cure of post-operative fistula and of cicatricial contracture of the bladder outlet. Finally, the persistent post-prostatectomy sepsis which is featured so largely in their published post-operative results is, in Kenneth Walker's words, "sometimes so troublesome that patients have learnt to wash out their bladders daily with as little difficulty as most of us experience in cleaning our teeth".

One would have felt justified in thinking—unless, of course, one's statements were entirely disbelieved—that a welcome would be assured for a method which promised even partial immunity from the appalling list of post-operative sequelæ so frankly acknowledged by these surgeons, and a reduction of the high mortality, which is stated to be "in the region of eighteen per cent. at general hospitals and eight per cent. at special hospitals".

In addition to the reduction of the mortality and morbidity rates resulting from the author's operation, the convalescent period has been shortened and made infinitely more comfortable. The immediate and positive control of hæmorrhage by suture lifts a load from the minds alike of patient and surgeon. The absence of post-operative urinary leakage through the wound, which, though by no means invariable, has been the general rule, is a further comfort. As stated above, in the entire series of 371 cases there has been no single instance of post-operative fistula formation or of recurrence of obstruction. There has been one instance of post-operative hernia in the entire series.

In the operation practised by the author there are two factors of safety which are of paramount importance, inattention to either of which is likely to spell failure to the plastic portion of the operation however carefully this may be carried out. These are: (1) The employment of surgical asepsis and antisepsis in the care of the catheter in both the pre- and post-operative periods; and (2) The employment of the intra-urethral method of digital enucleation of the prostate.

1. **The Indwelling Catheter and the Demand for Surgical Cleanliness.**—The most careful aseptic and antiseptic ritual must be observed in the care of the indwelling catheter when this is employed, both in the pre- and post-operative periods. Any slovenliness in this regard, apart from any immediate ill effects, will reap its own harvest of post-operative septic sequelæ. The method, so often seen, of allowing the open end of the catheter to drain into a urinal placed between the patient's thighs is fraught with danger and should no longer be tolerated; the way is wide open for infection which is not slow to develop. Only less objectionable is allowing the end of the catheter, perhaps plugged by a wooden peg, to swing loose among the bed-clothes.

2. **The Intra-urethral Method of Digital Enucleation of the Prostate.**—The method of Freyer which held sway for so many years is too liable to be associated with complete removal of the verumontanum, the anterior commissure, the anterior portion of the prostatic urethra down to the triangular

ligament, and sometimes even the membranous urethra. An unnecessarily wide and particularly vulnerable area is thus opened up for infection. In the author's practice the few cases in which the verumontanum has been accidentally removed are the only ones in which a slight tendency to persistent post-operative urinary leakage has developed, and, by the same token, were the only ones which required the passage of a sound at any period during convalescence. Particularly would the author desire to utter a word of warning against the open instrumental method of carrying out Freyer's operation, as this must almost of necessity entail complete removal of the prostate, verumontanum, anterior commissure, and prostatic urethra. No method of plastic surgery, however well carried out, will overcome the above-mentioned defects in enucleation. With the method of bimanual intra-urethral enucleation employed by the author (*see below*), which is merely an elaboration of that described many years ago by Bentley Squier, of New York, the verumontanum is preserved, the anterior commissure is not disturbed, and the mucosal covering of much of the prostatic urethra remains intact (*see Fig.* 299).

SURGICAL PRINCIPLES INVOLVED AND OPERATIVE REQUIREMENTS.

The operation places suprapubic prostatectomy in line with accepted principles of general surgical practice in so far that it makes immediate provision for: (1) The positive control of hæmorrhage by suture; (2) The re-formation of the prostatic urethra; (3) The covering up of raw surfaces and obliteration of dead spaces (viz., the prostatic cavity and the cave of Retzius); (4) The abolition of unnecessary drainage (i.e., of suprapubic cystostomy); and (5) First-intention healing. The first three are the vital or essential principles of the operation, and they are therefore of primary importance; the complete closure, though also extremely valuable, is by comparison a secondary consideration.

The operation demands complete visual exposure of the base of the bladder, and may, if so desired, be performed through a long vertical or transverse incision, when only one special instrument—namely, the combined needle and needle-holder—will be essential; or, as the author prefers to do it, through a short transverse incision, from $2\frac{1}{2}$ to 3 in. in length, for which a set of self-retaining, electrically-lighted bladder retractors has been devised (*see below*). Any desired bladder retractors may be employed in conjunction with a larger incision, but the set illustrated (*see Fig.* 297) widely opens up the bladder base and prostatic cavity, and permits the employment of a much smaller incision without impairing the facility with which the successive steps of the operation may be carried out. When the complete closure is practised in conjunction with a long incision of the abdominal parietes and bladder, drainage of the prevesical space *must be provided.* The author's experience and voluminous correspondence have shown the very real risk of urinary extravasation when this precaution is omitted. This very serious complication has not been encountered by the author in this last five-year period, i.e., during the currency of the present operation.

SPECIAL INSTRUMENTS.

The special instruments employed are four in number; they are as follows :—

1. **The Boomerang Needle-holder.**—An improved and perfected design. This needle-holder is now well known. It is a modification by the author of the well-known pattern of Young. The actual length assembled, but excluding the needle, is 9¼ in.; the over-all length, with the large-size needle mounted, 10 in. The author's large-size needle only is illustrated (*Fig.* 296), the smaller being approximately two-thirds the size. The large-size needle is indispensable for the placing of the trigonal and of the anterior sutures in the operation as now performed. A smaller needle does not take a sufficiently wide bite.

Fig. 296.—The author's large-size boomerang needle. There is no cutting edge: the point alone is sharp. (× ⅔.)

In order to avoid hæmorrhage from the needle puncture it is important that the needle should not have a terminal sharp cutting edge. The needle should be sharpened only at the actual point. It is made of rustless steel and must be kept sharp.

The sole drawback in the past to the use of this needle-holder has, in the author's experience, been the occasional 'jumping out' of the needle from the end of the needle-holder. This difficulty has now been overcome by replacing the locking pin of the original design with a small and readily adaptable double clip and pin device (*see Fig.* 304) which is positive in action and made of rustless steel. The complete instrument is made by Messrs. Elliotts and Australian Drug Limited, O'Connell Street, Sydney.

2. **Ligature Carrier for the Boomerang Needle-holder.**—The use of this carrier renders easy the placing of the suture in the needle. It has been described in previous publications.

3. **The Bladder Retractors and Self-retaining Frame.**—The set consists of three electrically-lighted retractors, two lateral and one posterior, adapted from the old handled pattern of Thomson-Walker (*Fig.* 297). The lamp for the left retractor is carried near the top of the blade, that for the right near the bottom, while for the posterior the light is set about the centre. An even diffusion of light is thus procured.

The value of this set of retractors has been greatly enhanced by the addition, since the last publication, of a self-retaining frame. This is of a very simple design and made in two parts with a 'pull-and-push' union for ease of sterilization and transport (*Fig.* 297).

The couplings for the two lateral retractors are set on the frame at an angle, so that the retractor stems run obliquely from without inwards and downwards. By this means the retractor blades are given an outward and upward cant and bear directly on the side walls of the bladder, while there is little, if any, pressure on the abdominal parietes. This ensures wide lateral retraction of the bladder base.

4. **Anterior Retractor.**—In addition to the self-retaining set, a narrow

recurved, long, anterior retractor made of spring steel is employed which dips below the anterior lip of the prostatic rim and lifts this forward, thus widely opening up the prostatic cavity and greatly facilitating the placing of the sutures (*Fig.* 297, 304).

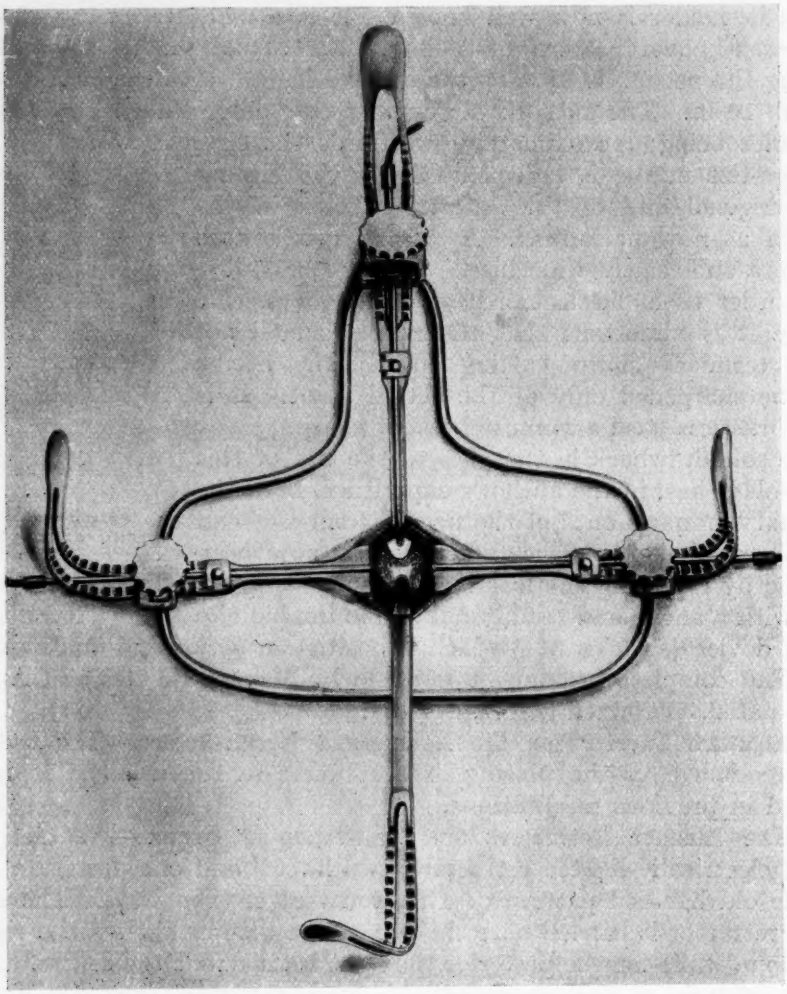


FIG. 297.—The author's electrically-lighted bladder retractors and self-retaining frame. The anterior retractor is not electrically lighted and does not connect with the frame. The complete exposure of the field of operation is well shown. The tip of the anterior retractor is seen lifting the anterior lip of the prostatic cavity forward.

PREPARATORY TREATMENT.

Preliminary catheter drainage is employed for at least ten days (or preliminary cystostomy for at least one month, in cases in which catheterization is unsuccessful) if the urine is dirty, if the residual urine exceeds 4 oz., or if the renal function is below par. Patients whose general condition is below par and who for that reason require pre-operative preparation often improve

to an extraordinary extent with a retained catheter, even when no residual urine is present. In this type as a rule, and generally in cases of any doubt, the retained catheter is employed as a preliminary, though sometimes intermittent catheterization combined with rest in bed may bring about the desired result in a more comfortable way.

Vas Ligation for the prophylaxis of epididymitis is practised as a routine. The earlier in the preparatory treatment the insertion of the sutures, the more successful will be the result. Silkworm gut subcutaneous transfixion sutures are used, and removed after seven days.

Method of Emptying an Over-distended Bladder.—Any suitable rubber or silk catheter is passed and its funnel end closed. The smallest size hypodermic needle is then plunged through the wall of the catheter into its lumen. A length of narrow rubber tubing connects the hypodermic needle to a bottle at the bedside. Not more than 4 oz. of urine per hour are allowed to flow through the needle. To ensure this it may be necessary partially to obstruct the rubber tubing. When the bladder is emptied, generally at the end of twenty-four or thirty-six hours, the needle is removed and the catheter is connected up to a bottle at the bedside as described below. This method is of proved safety and simplicity, and is very generally applicable.

Routine Adopted when a Retained Catheter is Employed.—The bladder is washed out thoroughly once or, if necessary, twice daily with a solution of permanganate of potash of pale pink colour, then with plain sterile water, and completely emptied. Four ounces of a 1–3000 solution of silver nitrate are then run into the bladder and the catheter is clamped for half an hour. When the bladder is dirty the strength of silver nitrate is increased gradually to the limit of tolerance, sometimes even up to 1–1250. Generally the dirtier the bladder the greater the tolerance for silver nitrate. The silver nitrate solution must not be strong enough to cause pain.

The catheter is drained by a glass connecting tube and a length of rubber tubing to a bottle at the bedside containing antiseptic solution, into which the tubing dips. No method of antisepsis will clean up a dirty bladder, or prevent infection of a clean one, when the end of the catheter is placed, as is so often seen, in a urinal between the patient's thighs.

The catheter is changed at least every third day, the patient, if well enough, being given a hot bath between changes of catheter. Always before insertion of the catheter the glans penis is mopped with methylated spirit and the urethra irrigated with 1–5000 solution of oxycyanide of mercury. The catheter lubricant consists of 1–500 oxycyanide of mercury cream (tragacanth-glycerin).

Urinary Antiseptics.—Sodium benzoate, 15 to 20 gr. t.d.s., and hexamine, 10 gr. t.d.s. or oftener, are given by mouth. When sodium benzoate disagrees with the patient, acid sodium phosphate may be employed instead in the same doses. This medication is continued, except for a short remission after operation, throughout the patient's stay in hospital. Confinement to bed is usual only for the first day or two of the catheter treatment.

If this technique is faithfully carried out, there will be found few even badly infected bladders which cannot very efficiently be cleaned up, and the prostatic bed may thus be made a safe place for plastic surgery.

Digitalis.—This may generally be administered with advantage. It is, however, only prescribed after complete routine examination by a physician, which is insisted upon in all cases.

Indigo-carmine Test.—After a minimum of ten days when catheter drainage is indicated, but not until such time as the patient's condition is considered otherwise favourable, an intravenous injection of 10 c.c. of a 0·4 per cent solution of indigo-carmine is given. Unless a good blue coloration (*see below*) appears in the urine within ten minutes, the patient is considered unsuitable for prostatectomy for the present, and is either further prepared by the retained catheter or submitted to preliminary cystostomy. Under no circumstances is a prostatectomy undertaken, whatever the other tests of renal function may indicate, unless the result of the indigo-carmine test is considered good enough to warrant it. This is regarded as the final renal test of operability.

The present régime carries with it a considerable improvement in the operability rate. Patients, whose renal function would previously have been considered to render prostatectomy either hazardous or even inadmissible, are now with confidence offered the operation. Where formerly a dark blue coloration of the urine was deemed necessary in the final test of operability, operation is now safely undertaken in patients whose indigo-carmine test yields a very much lighter blue. Suitable efforts will, of course, have been made to bring it up to the usual dark blue coloration.

OPERATIVE TECHNIQUE.

The steps of the operation may be summarized as follows :—

1. Complete washing and emptying of the bladder and irrigation of the urethra immediately before operation.

2. Draping of the towels on the patient in such a way that separate and individual access may be had to the rectum, penis, and abdominal incision. This method has been described in previous papers.

3. A transverse incision through the skin and fat, 2½ to 3 in. in length and 1 in. above the level of the symphysis.

4. Incision of the bladder at the highest point, after pushing back the peritoneal reflection. All bleeding points on the cut edges of the bladder are carefully tied to ensure that there will be no post-operative bleeding from this source.

5. The enucleation of the prostate. The bimanual method of intra-urethral enucleation of the prostate is employed by the author, two fingers of the left hand, on which two gloves are worn, being passed into the rectum. With the small transverse suprapubic incision which he uses, the added assistance afforded by the fingers in the rectum is invaluable. The right forefinger is passed into the prostatic urethra and breaks its way through the mucous membrane at the antero-inferior aspect of one or other lateral lobe and just external to the verumontanum. The inferior and superior borders of the lateral lobes are followed round to the mid-line first on one side and then on the other (*Fig.* 298). At the end of the enucleation the parts are left approximately in the condition shown in *Fig.* 299. By this method the prostate

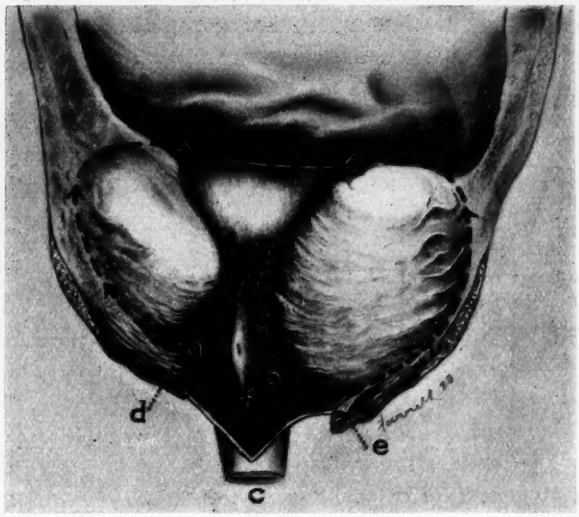


FIG. 298.—Drawing of post-mortem specimen of bladder and prostatic urethra, opened from the front, illustrating the intra-urethral method of enucleation of the prostate described in the text. The broken black line and the arrows thereon indicate the course followed by the finger during the enucleation. The points **a** and **b**, opposite the antero-inferior aspect of each lateral lobe, indicate the site at which the enucleation is begun on each side; **d** and **e**, The cut edges of the muscle of the anterior commissure; **c**, The membranous urethra; **f**, The verumontanum.

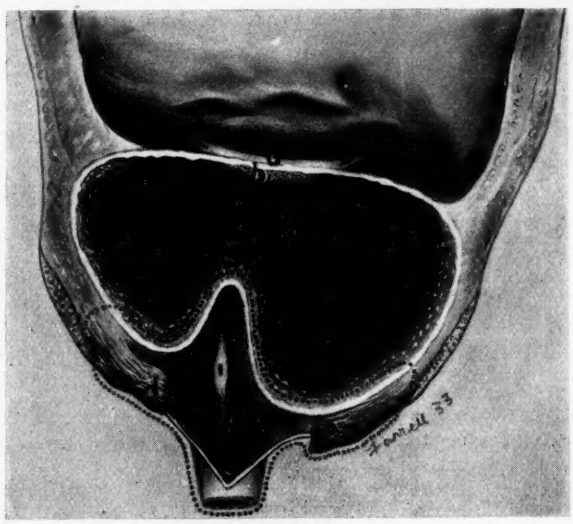


FIG. 299.—Same specimen as *Fig.* 298 after enucleation of the prostate. The heavy white line outlines the resulting cavity. It will be noted that the membranous urethra, the verumontanum, and the prostatic urethra around and distal to it have been left intact. The anterior commissure has been divided in this specimen for the purpose of exposing the interior of the prostatic urethra; during an actual operation it is left intact. The dotted black line surrounds the additional area which is commonly removed when the Freyer, particularly the open instrumental, method of prostatectomy is employed. **a**, The inter-ureteric bar; **b**, The trigonal muscle; **c**, The membranous urethra; **d** and **e**, The cut edges of the muscle of the anterior commissure; **f**, The verumontanum. (Semi-diagrammatic.)

can be cleanly and speedily removed with the greatest gentleness and facility. This result is accomplished with an almost complete absence of bruising and with a minimum of disturbance of the surrounding tissues.

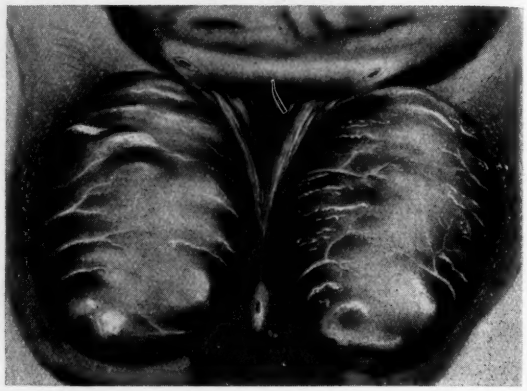


FIG. 300.—Drawing of post-mortem specimen of bladder and prostatic urethra opened from the front, and showing lateral lobe enlargement of the prostate with a perfectly normal posterior commissure.

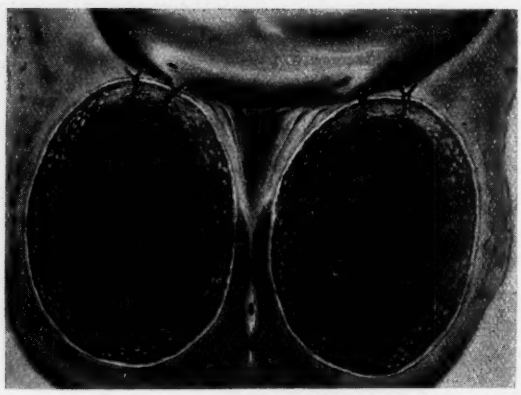


FIG. 301.—Same case as *Fig.* 300 after removal of the lateral lobes. The trigone has remained undisturbed in its normal position. Two hæmostatic sutures are shown on each side. (Semi-diagrammatic.)

FIG. 302.—From the same specimen as *Figs.* 298, 299. The trigonal tongue is shown sutured in position as in the author's operation. (Pre-inserted here for ready comparison with the previous figure and to emphasize how closely reproduced is the normal anatomical relationship of the trigone and prostatic urethra.) (Semi-diagrammatic.)

6. Visualization of the prostatic cavity and removal of any adenomatous remnants or tags.

7. Insertion of the individual hæmostatic sutures in the postero-lateral segment of the prostatic rim to control the gross hæmorrhage (*see below*).

When, as occasionally happens, the lateral lobes are enlarged without any involvement whatever of the posterior commissure (*Fig.* 300), it will sometimes be found that the enucleation has resulted in the separate removal of each lateral lobe, the trigone being left intact and undisturbed (*Figs.* 301, 302).

8. Reconstruction of the floor of the prostatic urethra by suturing a wide muscular tongue of trigone into the prostatic cavity (*see below*). No. 3 plain catgut is used for these sutures. This step, so far from producing deformity as claimed by some critics, not only re-forms the floor of the prostatic urethra, but also straightens out the trigone, gives to its muscles a 'point d'appui', and puts it in position to resume its physiological rôle of pulling open the internal urethral orifice during the act of micturition (*Fig.* 302).

9. Obliteration of the prostatic cavity and re-formation of the side walls of the new prostatic urethra by two deep anterior transverse sutures of No. 3 catgut; these also finally control the venous oozing which normally occurs from the prostatic cavity after prostatectomy. Very rarely a third suture may be required when a very large cavity is present (*see below*). The newly formed prostatic urethra is always left open wide enough to admit the tip of the first finger, which is generally passed through it to guide the catheter up into the bladder during its insertion at the end of the plastic portion of the operation. All bleeding should be controlled before the catheter is passed. The catheter itself, as indicated above, plays no part in the control of hæmorrhage, ample room always being left round it to allow of drainage upwards into the bladder from the remnant of the prostatic cavity. Experience has proved that tight suturing of the prostatic rim round the catheter predisposes to sloughing of the contiguous parts and to secondary hæmorrhage.

10. Insertion through the urethra into the bladder of a rubber catheter, size 22 F., preparation of its vesical end, and transfixion by a needle armed with silkworm gut (*see below*).

11. Valvular closure of the bladder, obliteration of the space of Retzius, and closure of the lower angle of the incision in the aponeurosis by one single three-looped extended figure-of-eight suture of No. 3 plain catgut (*see Fig.* 308). This suture has been described in detail in previous publications. If, for any reason, an unduly large incision has been made in the bladder, the lower angle is first closed separately by one or, if necessary, more figure-of-eight sutures. These serve both to bring the muscle of the bladder wall together and to invert the cut edges in this situation. The remainder of the bladder incision is then closed by the single three-looped suture.

12. Complete closure of the abdominal wound.

13. Suspension of the vesical end of the catheter by tying the silkworm gut transfixion suture round a glass rod lying on the abdomen (*see Fig.* 308).

The Postero-lateral Hæmostatic Sutures.—From two to four sutures of No. 2 plain catgut are placed on either side of the mid-line in the posterior third of the rim of the prostatic cavity (*see Figs.* 301, 302, 304), which, in a properly conducted prostatectomy, is the site of the gross hæmorrhage in the vast majority of cases. Where two sutures have been placed on one side and gross bleeding is still taking place from the region between these

two sutures, the loose ends of these sutures may be tied together. Great care should be taken when two sutures are tied together in this way that no undue narrowing of the prostatic rim takes place in the direction of its circumference, as this would make it more difficult to draw down the trigonal tongue, and would thus predispose to ledge formation. Should bleeding still persist in front of or behind these sutures, further sutures should be placed in front of or behind those already placed. In no circumstances is a postero-lateral suture of one side tied across the mid-line to a postero-lateral suture on the opposite side, as this would deliberately encourage ledge formation.

After bleeding has been controlled in the region served by the postero-lateral sutures, gross bleeding may occasionally be seen from a large artery or vein lying deeply on the more anterior portion of the prostatic rim. When this occurs an individual suture should be placed around the bleeding point with the boomerang needle, since the anterior obliterative sutures when they are tied may not afford sufficient compression. All bleeding from the prostatic rim must be definitely controlled before proceeding further.

As the author has pointed out in previous papers, when the bleeding is arterial, the sutures should be placed in front of the bleeding point; when venous, behind.

The Posterior or Trigonal Suture.—In all cases the needle for the trigonal suture now embraces a much wider extent of tissue than described in previous communications. The point of entry of the needle is well down behind the base of the trigone (*see Fig.* 304). It is, of course, necessary to visualize the ureteral orifices before inserting the needle. If this is done, no fear need be entertained of compression of them when the suture is tied. The point of the needle is made to emerge in the prostatic cavity as far forward, i.e., as deeply, as possible.

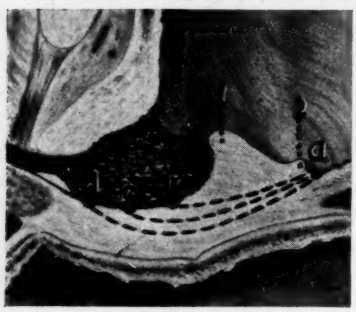


FIG. 303.—Sectional view showing needle tracks, **ab**, **ac**, **ad**, for three satisfactory grades of trigonal flap. 1, Torn apex of trigone. 2, Inter-ureteric bar; ab and sometimes ac do not require the use of the special capsule forceps; for ad, which yields the best results, the capsule forceps are essential.

For record purposes the author grades the trigonal flap according to its depth of penetration into the prostatic cavity as 'A', 'B', or 'C'.

In 'C' the flap is pulled well down into the prostatic cavity, almost completely reforming the floor of the prostatic urethra (*see Fig.* 302 and *Fig.* 303 ad). In 'B' (*Fig.* 303, ac) the flap penetrates not so deeply, and in 'A' (*Fig.* 303, ab) the flap is sewn down even more superficially, but at the least in such a way that the horizontal muscular shelf or projecting ledge, which appears in this position after removal of the prostate, is converted into a steep vertical gutter. This gutter will be even further accentuated when the anterior transverse sutures are tied (*see Fig.* 307) and the flap becomes firmly bedded in position (*see below*).

The employment of flap 'A' or 'B' makes for greater simplicity of the operative technique, since the boomerang needle may generally be passed deeply enough through the prostatic capsule to form one or other of these

flaps without the aid of the special capsule forceps which have been described in previous publications.

Except that these more superficial methods of fixing the trigonal flap carry a considerably greater liability to suprapubic leakage of urine after removal of the catheter on the tenth day, the ultimate results seem to be as good as when flap 'C' is made. Experience has shown that, *ceteris paribus*, the better the flap, the less is the leakage.

Although the author's preference is very decidedly for the employment of the capsule forceps and of flap 'C' (*Fig.* 304), where this is possible, he has

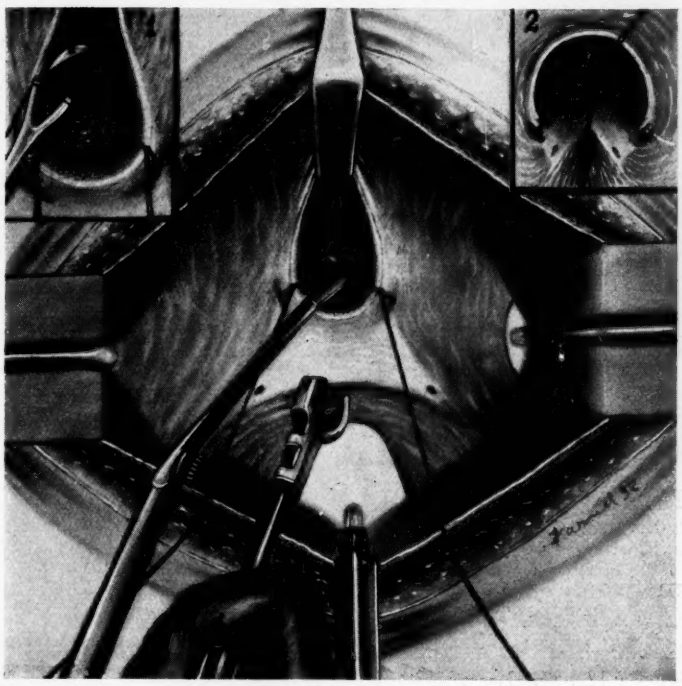


FIG. 304.—Formation of the trigonal flap: the needle enters behind the interureteric bar and emerges through the prostatic capsule at b. The special capsule forceps are picking up the prostatic capsule. Two hæmostatic sutures only are shown for the sake of simplicity. The new locking device for the boomerang needle is shown on the needle-holder.

Inset 1 shows the point of the needle emerging through the prostatic capsule: the suture carrier in position.

Inset 2 shows the trigonal suture tied, drawing down into the prostatic cavity the entire thickness of the trigonal tongue with its subjacent muscle and re-forming the floor of the prostatic urethra.

carried out a considerable number of operations employing flap 'A' or 'B' and has had no cause for regret.

So far as the risk of perforation of the rectum by the needle is concerned, this is a practical impossibility with the technique and needle described. This accident has never happened either in the author's hands, or, to the best of his knowledge, elsewhere.

During the tying of the trigonal suture the tip of the operator's left forefinger, if he is standing on the patient's left side (which is the author's practice)

should push down the knot as far as possible into the prostatic cavity (*Fig.* 305); this ensures that the trigonal tongue will be carried down to the lowest part of the loop when it is tied (*see Fig.* 302). If the right forefinger is used for this purpose, it will be found very difficult to pass this deeply enough into the prostatic cavity, and the tendency will be to draw the trigonal flap upwards away from the prostatic cavity when tying the knot.

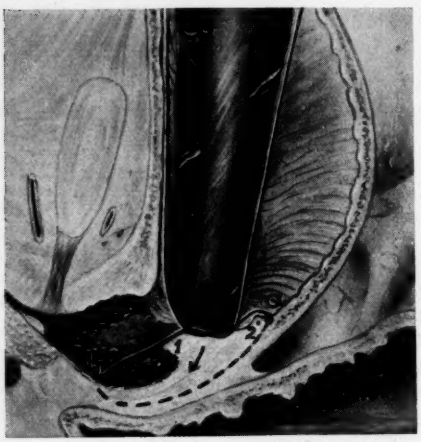


FIG. 305.—Sectional view showing the method of tying the trigonal suture, the left fore-finger pushing well down into the prostatic cavity. ab, Track of needle; 1, Torn apex of trigone; 2, Interureteric bar.

The Anterior Transverse Obliterative Sutures.—In the vast majority of cases two anterior transverse obliterative sutures are employed, though one may suffice for a very small cavity, and a particularly large cavity may very occasionally demand the use of three. One suture is tied before the next is placed.

The first, or most anterior suture, passes transversely at a tangent to the anterior segment of the prostatic rim as shown in *Fig.* 306. The second is parallel to the first and bisects what remains of the prostatic cavity. These sutures traverse the prostatic cavity deeply from side to side, just missing its floor in the depths. They will lie above and in front of the catheter when it is passed.

Greater efficiency has been attained for these sutures by increasing the extent of their bite. The needle for each stitch now perforates the bladder base much more widely out on each side than formerly, and, in fact, takes about as wide a bite of the whole thickness of the bladder muscle in this situation as it can be made to hold. There results from this not only more nearly complete obliteration of the prostatic cavity, but also a wide inversion of the rim of the prostatic cavity and adjoining portion of the bladder base, thus largely reforming the side walls of the new prostatic urethra. During the process of tying these sutures the trigonal tongue sinks progressively to a lower plane, until finally it disappears almost entirely from view. It is thus made to penetrate even more deeply into its position in the prostatic cavity, in which it is now very firmly bedded (*Fig.* 307, inset). At the termination of the operation there should be no visible raw surface and no bleeding.

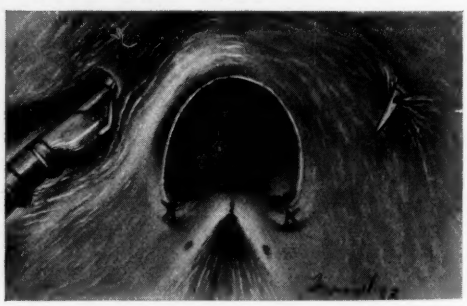


FIG. 306.—Needle in position for the first anterior transverse obliterative suture. Note the width of the bite of the needle. Trigonal tongue in position—two hæmostatic sutures only are illustrated for the sake of simplicity.

Preparation of Retained Catheter. — A thin-walled rubber catheter of size 22 F. is employed. This is measured by gauge and not by the maker's marking.

After the catheter is passed into the bladder a second eye is cut about one inch from the tip, and the end of the catheter is cut off transversely just beyond this new eye. The full calibre of the catheter is thus made available for drainage (*Fig.* 307).

It has been found important to make sure that, owing to faulty manufacture, there is no narrowing at any point throughout the lumen of the

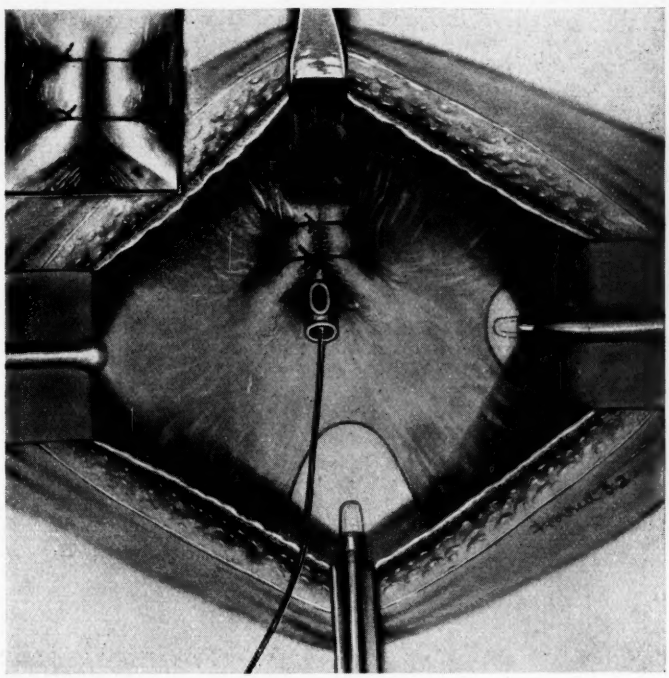


FIG. 307.—Second transverse obliterative suture inserted: plastic operation completed: catheter with silkworm-gut transfixion suture in position. The catheter is passed intact and the tip cut off after a second eye has been made.

Inset: Same stage before passage of the catheter. Note that there is no visible raw surface, that the trigonal flap lies on a plane below that of the rest of the bladder base and is firmly bedded in position, and that the lateral edges of the prostatic rim are deeply inverted, thus partly re-forming the side walls of the new prostatic urethra.

catheter. This was the cause of inefficient drainage in two of the author's cases. All catheters are now tested before use by passing through them a full-size obturator.

If, as occasionally happens, it is found that the catheter is too large to pass through the urethra into the bladder, no apprehension need be felt, as the catheter plays no part either in the control of hæmorrhage or in the urethral reconstruction. Suprapubic drainage should be instituted, and the bladder will be found to close rapidly after removal of the suprapubic drainage tube. As a matter of fact, the complete closure, though a valuable asset,

is rather in the nature of a comfort and convenience to the patient than a vital factor in the final outcome.

The operation is completed as shown in *Fig.* 308.

Prostatectomy in the Presence of Diverticulum of the Bladder.—When the diverticulum is of such a size that it can be dealt with from within the bladder, the complete operation (i.e., diverticulectomy plus prostatectomy) may be undertaken at the same sitting, provided it has been possible by preliminary preparation to cleanse the diverticulum efficiently of its foul content. When the diverticulum is larger and demands extravesical removal, or, in any case, when the content remains foul in spite of treatment, the

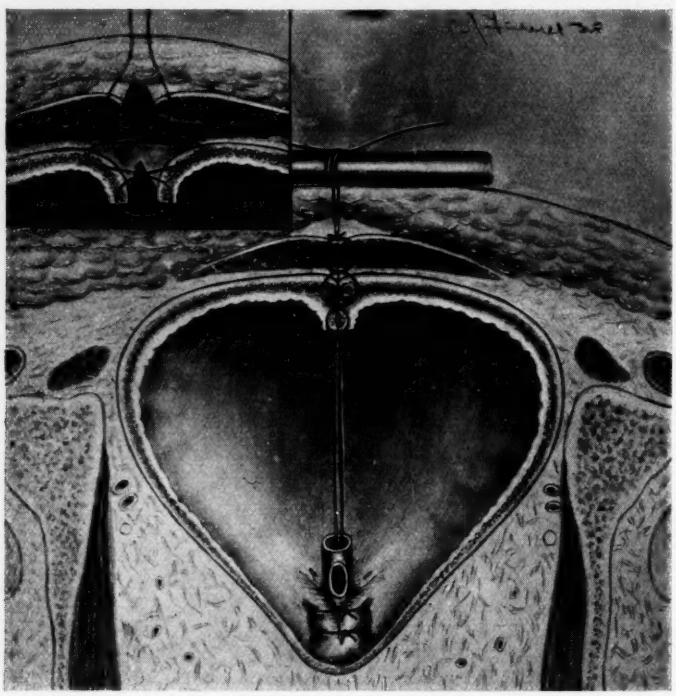


FIG. 308.—Sectional view of the completed operation seen from below. The three-loop suture is tied, approximating the bladder muscle, making a valvular inversion of the cut edges, obliterating the space of Retzius, and closing the lower angle of the incision in the aponeurosis. The catheter is tethered to the glass rod lying on the abdomen.

Inset: The three-loop or extended figure-of-eight suture, partially tightened. The catheter suture has been omitted to avoid confusion.

author prefers as a rule to remove the diverticulum at a preliminary operation in conjunction with cystostomy if the patient's condition warrants it, the prostatectomy being deferred to a later stage. In some cases, however, when the general condition of the patient was not such as to warrant any prolonged procedure, he has combined a plastic widening of the diverticular stoma, generally by means of a vertical downward incision terminating as close as possible to the internal urethral orifice, with prostatectomy and the usual plastic procedure on the prostatic cavity. The advisability of associated suprapubic drainage in cases of this type depends on the foulness or otherwise of the diverticular content.

Paraffin Method of Cleansing a Foul Diverticulum.—A diverticulum with offensive contents may often be rapidly and efficiently cleaned up by injecting a sufficient quantity of liquid paraffin into the bladder, after its routine daily irrigation, thoroughly to distend the diverticulum. When the excess is allowed to flow out of the bladder, the diverticular orifice will generally contract down and retain the remnant of oil in place of its previous content of decomposing urine.

Two-stage Prostatectomy with Closure. — A preliminary cystostomy is practised only when either catheterization is impracticable or it has been impossible to bring about sufficient improvement by catheterization to warrant the one-stage operation.

The prostatectomy is not undertaken until at least one month after the cystostomy in order to allow of subsidence of the wound induration. The patient in the interval is up and about with a small-gauge permanent cystostomy tube in position. When the prostatectomy is undertaken a vertical incision is carried downwards from the cystostomy opening, which, in these cases, has been made through a transverse skin incision two inches above the level of the symphysis. The same plastic technique on the prostatic cavity is carried out as in the one-stage operation.

A second set of bladder retractors, of the same design though half the width of those described above, has been made for use in the occasional case in which the latter cannot be introduced through the more restricted space available in the two-stage operation.

Water-tight closure of the abdominal wall is, of course, not so readily obtained in these cases. It is surprising, however, how little urinary leakage actually occurs. The leakage in this series of cases persisted in few beyond the twelfth and in none beyond the twenty-eight day.

The Post-operative Catheter Drainage.—At the termination of the operation, and before the patient leaves the operating table, a few syringefuls of 1–5000 oxycyanide of mercury solution are washed backwards and forwards through the catheter to remove the blood-clot which invariably will be found to have formed in the catheter. A wide-bore glass connection is then placed in the funnel end of the catheter and inserted into a sterilized 8-oz. glass bottle, into which some of the oxycyanide of mercury solution flows back from the bladder. When the patient is returned to bed the catheter is connected up in the usual way by a length of rubber tubing to a bottle at the bedside.

A careful watch must be kept on the catheter, especially for the first twenty-four or thirty-six hours, to ensure continuity of drainage. When the operation has been properly carried out, with all due attention to hæmostasis, there will rarely be any cause for anxiety in this regard. It is axiomatic that no bladder should ever be completely closed when the bleeding has not been adequately controlled. On this point there should be no room for errors of judgement.

The majority of patients require no interference with the catheter, but should any doubt be entertained about the continuity of the drainage there should be no hesitation in injecting, repeatedly if necessary, ½ oz. of 1–3000 solution of silver nitrate to free the catheter of possible clots.

Irrigation of the bladder, beyond the amount necessary to free the catheter of clot, is neither necessary nor permitted.

Spasmodic and painful contractions of the bladder sometimes occur during the first two or three days of convalescence, especially in fat patients. This can generally be overcome or minimized by leading the rubber drainage tube below instead of over the patient's thighs.

The catheter is retained in position until the tenth post-operative day. It is removed by cutting across the silkworm-gut suture immediately below the glass rod. The hairpin-shaped remnant of silkworm gut comes away with the catheter. Most patients are out of bed on the eleventh day.

Post-operative Hæmorrhage. — Post-operative hæmorrhage, reactionary or secondary, of sufficient severity to demand cystostomy has been extremely rare throughout the series. It has occurred only once in the last 273 cases.

An injection into the buttock of from 1 to 2 oz. of whole blood, which need not be typed for this purpose, has seemed of value in the few cases in which its use was called for on account of the persistent formation of clots interfering with the continuity of drainage through the catheter, either before or after prostatectomy.

SUMMARY.

1. The author's operation of suprapubic prostatectomy with closure is described in detail.

2. The results obtained during the five years' currency of this operation down to October, 1932, are presented.

3. The number of cases submitted to prostatectomy was 371, the deaths were 10, the mortality rate was 2·7 per cent.

4. The operation is decidedly not one for the occasional prostatectomist, but the technique will present no insuperable difficulties to those experienced in this branch of surgery.

5. The essential features of the operation are the immediate control of hæmorrhage by suture, the re-formation of the prostatic urethra, and obliteration of the prostatic cavity, combined with immediate closure of the bladder and abdominal wound.

6. In addition to the improvement of mortality, morbidity, and operability rates, manifested by this operation as compared with other widely practised methods of suprapubic prostatectomy, this operation also completely obviates post-operative recurrence of obstruction. Further, the various septic manifestations, which have been the bugbear of prostatectomy, have almost completely disappeared.

REFERENCES.

[1] *Med. Jour. of Australia*, 1927, March 26, 460.
[2] *Surg. Gynecol. and Obst.*, 1930, Jan., 251.
[3] *Med. Jour. of Australia*, 1927, Oct.
[4] *Brit. Jour. Urol.*, 1929, Sept., 285.
[5] *Brit. Med. Jour.*, 1932, ii, 192.

ENLARGEMENT OF THE ANTERIOR PORTION OF THE PROSTATE GLAND.

By BRENNAN S. CRAN,

CARNEGIE TEACHING FELLOW, DEPARTMENT OF PATHOLOGY, UNIVERSITY OF ABERDEEN.

THE following case of enlarged prostate is of interest in view of the unusual involvement of the anterior portion. Very few similar cases have been recorded (Wade,[1] Young,[2] and Walker[3]). In a series of 77 prostate glands removed at autopsy in which simple enlargement was present I found involvement of the anterior portion in only one, and Riches and Muir[4] in their series (59 cases) report an incidence of 1 per cent.

The prostate gland is composed of five lobes: two symmetrical lateral lobes, an anterior lobe in front of the urethra, a posterior lobe behind and below the ejaculatory ducts, and a middle lobe situated in the acute angle between the posterior urethral wall and the ejaculatory ducts. This classification has an embryological basis, notwithstanding the fact that before birth the demarcation between the lobes has disappeared with the exception of the posterior mid-prostatic groove which separates the lateral lobes. As is well known, simple enlargement affects the median or lateral lobes, and, in my experience, practically always both, although enlargement of one of them may predominate.

CASE REPORT.

Unfortunately no history is available, as the patient, aged 71, was admitted to the Aberdeen Royal Infirmary in a comatose condition, with laceration of the brain and fracture of the skull resulting from an accident; he died without regaining consciousness.

POST-MORTEM FINDINGS.—At the autopsy, on opening the bladder, which was moderately distended with urine, an enlarged prostate was found with an intravesical projection of about the size of a fairly large marble; this overhung and partly occluded the internal meatus which lay behind it. The median and lateral lobes, which were but very slightly enlarged, did not produce an elevation of the floor of the bladder, the walls of which showed a moderate degree of muscular hypertrophy with trabeculation. A median sagittal section (*Fig.* 309) through the prostate demonstrated that the projection was not of polypoid nature, but part of a greatly enlarged anterior lobe which as a whole was approximately of the size of a walnut. The cut surface was studded with well-formed spheroids composed of hyperplastic prostatic glandular tissue, and, in all respects, its appearance was identical with that of a median- or lateral-lobe enlargement. The prostatic urethra was displaced backwards by the mass and formed a gentle curve. The posterior lobe was a trifle large for the age of the patient. Microscopic examination of the anterior lobe showed changes exactly analagous to those met with in the typical median- and lateral-lobe enlargement. The ureters, pelves, and kidneys presented no unusual changes, except deep passive congestion of the last named. There was no cystitis. No stricture of the urethra was present.

Wade's and Young's cases are illustrated by a photograph and drawing respectively, but, though admitting that this type of enlargement is rare, these writers give no further detailed account of these cases. In Wade's specimen " the disease was confined to the anterior lobe ", but in Young's case the median lobe was also enlarged but to a less degree.

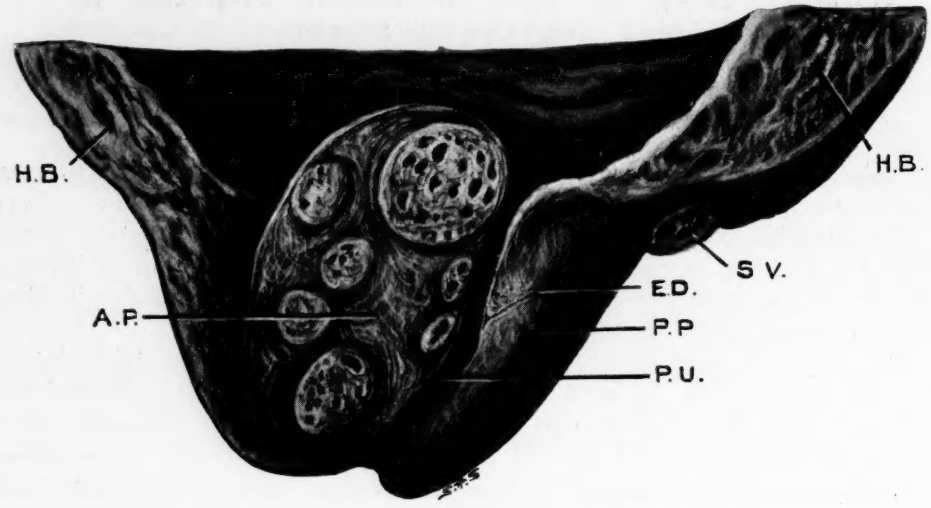


FIG. 309.—Median section showing the enlargement of the anterior portion of the prostate gland and the accompanying hypertrophy of the bladder. H.B, Hypertrophied bladder wall; A.P., Enlarged anterior portion of the prostate gland showing the intra-vesical projection and the well-formed cystic 'spheroids'; P.U., Prostatic urethra; P.P., Posterior portion of the prostate gland; S.V., Portion of a seminal vesicle; E.D., Terminal portion of an ejaculatory duct. (× 2.)

COMMENTARY.

1. Developmentally the glandules of the anterior lobe of the prostate are the first to cease growth and retrogression is apparent in the earliest years of life. In view of this it is difficult to understand why in exceptional cases these structures persist to an unusual extent and in later life may even become the site of hyperplastic changes, especially as no glandular deficiency is apparent in the rest of the organ, when such exuberance might be regarded as of a compensatory nature.

2. Anterior-lobe enlargement in itself is capable of causing urinary obstruction. This is well shown in my case by the presence of the hypertrophy of the bladder, no other likely causal lesion being found at the autopsy. This would tend to prove that interference with the integrity of the trigonal muscle is not a *sine qua non* in the causation of urinary obstruction in prostatic enlargement. During micturition the posterior segment of the bladder neck is drawn backwards so that the angle formed by the floor of the prostatic urethra and the trigone is increased, the one gradually meeting the other instead of at an acute angle; the anterior segment remains stationary. This mechanism is due to the contraction of the muscular fibres of the trigone, which run from their origin near the inter-ureteric bar to be inserted in the verumontanum.

It has recently been suggested by Walker[5] and others that an important cause of urinary obstruction in enlargement is interference with the action of this muscle, whether by infiltration of its fibres or by an increase in the size of the angle between the trigone and the floor of the urethra. Whilst this view undoubtedly must be true in many cases, especially in median-lobe hyperplasias and cases included under the term of 'prostatic bar', it cannot be universally so, as in the case I have described the disease was practically confined to the anterior segment of the bladder neck, and the trigone and floor of the posterior urethra were apparently unaffected.

It is probable that frequency of micturition had been present during life owing to the presence of the intravesical projection formed by the large anterior lobe, which, apart from playing the rôle of a foreign body within the bladder, undoubtedly would have caused stretching and irritation of the mucous membrane of the bladder neck. The mucosa in front of the meatus is, however, less sensitive than that covering the trigone, which is the part affected in median-lobe enlargement.

3. Rectal examination would fail to demonstrate the presence of an enlarged anterior lobe, although this would readily be seen on cystoscopy.

I wish to thank Professor Shennan for permission to publish this case.

REFERENCES.

[1] WADE, H., *Ann. of Surg.*, 1914, lix, 321.
[2] YOUNG, H. H., *Practice of Urology*, 1926, i, 424.
[3] WALKER, K., *Diseases of the Male Organs of Generation*, 1923.
[4] RICHES, E. W., and MUIR, E. G., *Brit. Jour. Surg.*, 1933, xx, 366.
[5] WALKER, K., *Brit. Med. Jour.*, 1933, i, 355.

AN INQUIRY INTO THE RESULTS OF SURGICAL TREATMENT OF GENITAL TUBERCULOSIS IN THE MALE.

By RALPH O. LEE,
RESIDENT ASSISTANT SURGEON, ST. THOMAS'S HOSPITAL;
AND KENNETH BOWES,
SURGICAL REGISTRAR, ST. THOMAS'S HOSPITAL.

Genital tuberculosis is a local manifestation of a general disease the ultimate cure of which depends upon the resistance of the patient to the attacking organism. General treatment in the form of improved hygienic conditions and rest, coupled with the administration of tuberculin, has been shown in a minority of cases to produce cure, but in the majority it fails to stop the spread of the disease through the seminal tract. Local rest without surgical interference cannot be obtained, and there can be little doubt that surgery used to remove obviously diseased organs is completely justified.

Published results of series of cases treated without operation are scanty but uniformly depressing. Barney[1] quotes 11 cases, 6 of which died of tuberculosis. Keyes[2] gives 30 per cent as his figure for cure in 24 cases, and Lelongt[3] using tuberculin claimed 33 per cent cures in 70 cases.

With surgical interference there is a distinct improvement. Orchidectomy and, more recently, epididymectomy have been the operations most widely practised, and numerous series of results have been published. These are difficult to compare, since the standard accepted for cure, and the length of time for which cases have been followed, vary with different authors. Simon,[4] in 107 cases treated by orchidectomy, claimed 57 per cent cured, no period of observation being given. Lapeyre,[5] who watched cases four to ten years after operation, claimed 75 per cent cures. Bruns,[6] reporting 111 cases, gave 40 per cent as cured in three to thirty-four years after operation, and out of 78 unilateral cases 60 per cent had the opposite side affected within four months of operation. Boguljuboff,[7] in 166 unilateral cases, showed a recurrence rate of 76 per cent, and Berger[8] had a corresponding rate of 60·4 per cent. Barney[1] quotes 49 cases of unilateral disease. Within three years of orchidectomy 37 per cent had the opposite side affected. Keyes,[2] in a similar series, gave a figure of 60·9 per cent. Young[9] gives a series of 85 cases treated by simple orchidectomy which have been thoroughly studied, and a summary of his findings is given below:—

	Per cent
Remained well or improved	46
Recurrence in opposite epididymis	31*
Recurrence in prostate or seminal vesicles ..	3·4
Remote mortality..	29
Operative mortality	Nil

* Of 45 unilateral cases.

The tendency to recurrence after orchidectomy, already well-known, is strikingly illustrated by these figures. This, and the remote mortality, has led surgeons to consider more radical procedures. Young is of the opinion that the disease begins centrally in the prostate and seminal vesicles, and strongly advocates a wide excision including the epididymis, vas deferens, one or both seminal vesicles, and portions of the prostate if these latter are involved.

If thoroughly carried out this is an operation of considerable magnitude, and in practice it is rarely feasible to do more than remove the diseased vesicle with the vas and epididymis in one piece. The problem therefore is: Does the removal of a diseased vesicle materially improve the prognosis? Young has published 24 cases treated by his radical operation. His figures show:—

	Per cent
Alive and well (up to 9 years after operation)	54
Recurrence in opposite epididymis (7 unilateral cases) ..	42
Remote mortality..	20
Operative mortality	4

Of other observers who have published figures of the radical operation, Baudet[10] in 58 cases claimed 78 per cent cured, one to six years after operation. Quinby[11] states that he performed the operation in 7 cases with good immediate results, but gives no after history. Whiteside,[12] however, quotes 22 cases, none of which were watched for more than two years, in which he considers the results are poor.

In order to determine the significance of vesicular enlargement and the value of this more radical treatment, a series of cases taken from a ten-year period has been followed and analysed. The details of most of the cases have been obtained from the records of St. Thomas's Hospital and the remainder are due to the kindness of Mr. C. A. R. Nitch. Eighty-nine cases which came under treatment during the years 1921–30 inclusive have been traced during 1932. Most of these were seen and examined by one of us, and wherever possible the urine was examined for the presence of pus and tubercle bacilli. The majority were subjected to limited operations, either orchidectomy or epididymectomy, but a smaller group underwent radical orchido-vaso-vesiculectomy. At the same time the opportunity has been taken to investigate the mortality of the disease, and the liability to ascending infection of the urinary tract.

The clinical extent of the disease when the patients first came under observation is given in *Tables I* and *II*. *Table I* contains primary genital cases, and *Table II* cases secondary to renal tuberculosis. Of the total 89, 48 showed enlargement of one or both seminal vesicles.

Table I.—Primary Genital Cases.

Unilateral epididymitis alone	32
Unilateral epididymitis with involvement of prostate or vesicles	40
Bilateral epididymitis alone	6
Bilateral epididymitis with involvement of prostate or vesicles ..	2
Total	80

Table II.—Cases Secondary to Renal Tuberculosis.

Unilateral epididymitis alone	2
Unilateral epididymitis with involvement of prostate or vesicles	5
Bilateral epididymitis alone	1
Bilateral epididymitis with involvement of prostate or vesicles ..	1
Total	9

Mortality.—The true mortality of the disease in the series was difficult to estimate, since, in cases dying some years after treatment, the cause of death could not always be ascertained. An analysis of the fatal cases is given in *Table III*.

Table III.—Analysis of Fatal Cases.

Immediate	Post operation	1
Remote	Pulmonary tuberculosis / Miliary tuberculosis	7
	Renal tuberculosis	1
	Probable tuberculosis	5
	Unascertained	5
		19

The patients included in 'probable tuberculosis' were known to have active disease when last heard from. The mortality from all causes during the period two to twelve years of observation is 21·3 per cent. The mortality from known or probable tuberculosis is 17 per cent. The only post-operative death followed a radical operation and was due to tuberculous broncho-pneumonia.

Ascending Infection of the Urinary Tract.—The close connection between genital and renal tuberculosis has long been recognized, with spread from kidney to epididymis as the usual route. It is a striking fact in this series that only 9 of 89 cases followed renal disease. The incidence of the reverse spread from genital to urinary tract is smaller still. In order to estimate this the urine of 50 patients was examined microscopically for the presence of pus and tubercle bacilli, specimens from twenty-four hour collections being used. In 40 cases the urine was clear. In 8 cases pus without tubercle bacilli was found, and in all of these there were no symptoms, the patients being otherwise well. In only 2 cases was pus with tubercle bacilli found. One of these cases followed renal tuberculosis; the other had had both testes removed for tubercle, the first in 1920; and in May, 1932, urinary investigation revealed a tuberculous pyonephrosis with much calcification. In view of the long previous involvement of the first testis, it is possible that the renal condition was secondary. This is the only example in 50 cases in which ascending infection of the urinary tract can be alleged.

Treatment.—The cases have been divided into four groups, and a classification modelled on that of Young has been used.

1. In the first group are 11 cases which did not undergo operation; in the majority this was because of the presence of active pulmonary disease. The diagnosis in the remainder was established on clinical grounds only, and may therefore be open to doubt. The present condition of this group of cases is given in *Table IV*.

Table IV.—Conservative Treatment.

Apparently inactive	6	
Apparently active	1	(bilateral)
Died of phthisis	4	
Total	11	

In most of these cases tuberculin was not used, and no estimate of its value can be given. It is noteworthy that over half of the cases are apparently inactive two to twelve years after first observation.

2. The second group contains 62 cases which were treated by a limited operation—either orchidectomy or epididymectomy; 21 of these cases showed vesicular enlargement prior to operation. The present condition of the group is given in *Table V*.

Table V.—Limited Operation (62 Cases).

Apparently cured	29 (46·6 per cent) (6 bilateral)
Recurrence in prostate or vesicles	3 (4·9 per cent) (1 bilateral)
Recurrence in opposite epididymis	22 (35·5 per cent)
Died without further urogenital lesions	8 (13·0 per cent) (1 bilateral)

Gross recurrence rate, 40·3 *per cent.*

Recurrence rate in opposite epididymis in 54 *unilateral cases*, 40·7 *per cent.*

3. The third group contains the 21 of these cases in which vesicular enlargement was noted. *Table VI* shows an analysis for comparison.

Table VI.—Limited Operation in 21 Cases in which Vesicular Enlargement was Noted.

Apparently cured	10 (47·6 per cent) (2 bilateral)
Recurrence in opposite epididymis	8 (38·1 per cent)
Died without further genital lesions	3 (14·3 per cent)

Gross recurrence rate, 38·1 *per cent.*

Recurrence rate in opposite epididymis in 19 *unilateral cases*, 42·1 *per cent.*

It is surprising that both liability to spread to the contralateral epididymis and gross recurrence rate are no higher than in the main group. In other words, enlargement of the seminal vesicles appears not to affect the prognosis.

4. The fourth group is composed of 16 cases in which radical operations were performed. Vesicular enlargement was present in all, and the vesicles on removal were caseous and microscopically showed active tuberculosis. The operation in each case consisted in removal of the epididymis (or testis) with the vas and seminal vesicle, usually in one stage. Portions of the prostate were not removed. The present condition of this group is given in *Table VII*.

Table VII.—Radical Operation (16 Cases).

Apparently cured	9 (56·3 per cent) (1 bilateral)
Recurrence in opposite epididymis	6 (37·5 per cent)
Post-operative death	1 (6·2 per cent)

Gross recurrence rate in recovered cases, 40·1 per cent.

Recurrence rate in opposite epididymis in 14 unilateral cases which recovered, 42·9 per cent.

Fifty-six per cent of these patients are now well without further operation, a figure which compares favourably with any of the preceding series. The remote mortality has been nil, and although it is difficult to attribute this entirely to the operation, it is very satisfactory. On the other hand, there appears for the first time a post-operative mortality, and the figures for recurrence show no improvement compared with those of the more limited operation, but are indeed slightly worse.

SUMMARY.

1. A series of 89 cases of genital tuberculosis in the male, occurring in a ten-year period, has been followed up and analysed.

2. The mortality of the disease appears to be about 20 per cent.

3. Upward extension of infection to the urinary tract is rare.

4. The recurrence rate after surgical interference is about 40 per cent. This figure is not influenced by the presence of a palpable vesicle before operation, nor by its surgical removal.

5. Radical operation with vesiculectomy, whilst not affecting the recurrence rate in the other epididymis, seems to decrease the remote mortality.

6. In this series radical operation has introduced an immediate mortality.

We should like to express our thanks to the surgeons of St. Thomas's Hospital who have kindly allowed us to investigate their cases, and in particular to Mr. C. A. R. Nitch, who first suggested this research and without whose direction and valuable criticism it would not have been possible.

REFERENCES.

[1] Barney, "Genital Tuberculosis" in Cabot's *Modern Urology*, 1924, 532.
[2] Keyes, *Ann. of Surg.* 1907, June, 918.
[3] Lelongt, *Thèse de Paris*, 1911, quoted by Barney.
[4] Simon, *Deut. Gesellschaft f. Chir.* 1901, xxx.
[5] Lapeyre, *Arch. gén. de Chir.*, 1912, viii.
[6] Bruns, *Deut. Gesellschaft f. Chir.*, 1901, xxx.
[7] Boguljuboff, quoted by Young, *Arch. of Surg.*, 1922, iv, 334.
[8] Berger, *Arch. f. klin. Chir.* 1901, lxviii, 915.
[9] Young, *Practice of Urology*, 1926, i, 278; *Arch. of Surg.*, 1922, iv, 334; *Surg. Gynecol. and Obst.*, 1918, April, 375.
[10] Baudet, *Rev. de Chir.*, 1901, i.
[11] Quinby, *Jour. Amer. Med. Assoc.*, 1918, Nov., 1790.
[12] Whiteside, *Calif. Jour. of Med.*, 1910 viii, 88; *Trans. Amer. Assoc. Genito-urin. Surg.*, 1914, ix; *North-western Med.*, 1919, xviii, 83.

CALCIFICATION, DECALCIFICATION, AND OSSIFICATION.*

By R. WATSON JONES,

HON. ASSISTANT ORTHOPÆDIC SURGEON, LIVERPOOL ROYAL INFIRMARY;
LECTURER IN ORTHOPÆDIC PATHOLOGY, LIVERPOOL UNIVERSITY;

AND R. E. ROBERTS,

HON. RADIOLOGIST, LIVERPOOL ROYAL INFIRMARY;
LECTURER IN RADIOLOGY, LIVERPOOL UNIVERSITY.

I. THE PATHOLOGY OF CALCIFICATION AND OSSIFICATION.

THE problems of bone growth have for many years attracted the attention of physiologists, anatomists, and biochemists, and many controversies have centred on the nature of the osteoblast and the osteoclast, the function of the periosteum, the chemical constitution of the bone salt, and the factors determining the deposition of this salt in the skeletal framework. To the clinician and the surgeon these problems have appeared to be chiefly of academic interest, and in no other branch of medicine has there been more confused thought, more inaccurate observation, and more unsound teaching, than in the clinical pathology of ossification, calcification, and decalcification of tissues. Bone formation has been attributed to the specific activity of osteoblasts, despite the fact that bone may develop in tissues far distant from any possible source of osteoblasts. The deposition of calcium in abnormal situations has not been correlated with the deposition of calcium in normal bone, and special theories have been formulated to account for it.[1] No clinical distinction has been clearly established between destruction of bone and simple decalcification. The association of decalcification of bone with the hyperæmia of infection has been accepted, but the same decalcification arising after fracture of the neck of the femur and leading to non-union has been attributed to impairment of the blood-supply. An identical pathological entity has therefore been attributed to exactly opposite pathological processes.

Although experimental observation is still incomplete, the work which is already established is sufficient to enunciate principles of the most vital clinical significance. The osteoblast can no longer be regarded as a cell endowed with the specific power of laying down bone. It is merely the cell of a mesenchymatous tissue in which inorganic salts may be deposited, absorbed, redeposited, and reabsorbed according to the local influence of enzymes, and under the general control of endocrines. This is not a property

* Based on a paper by R. Watson Jones read before the Innominate Club, Liverpool, September, 1931, and a joint paper by R. Watson Jones and R. E. Roberts read before the Radiological Section of the Royal Society of Medicine, March, 1933.

peculiar to bone cells. A similar power to effect the deposition of inorganic salts is possessed at certain stages of development by the cells of cartilage and of fibrous tissue. The bone cell has no more specific power than the cartilage cell or the fibrous-tissue cell, and in fact all of these cells are of the same type. The early undifferentiated mesenchyme of the embryo forms a common mesoblastic stem from which may develop either fibrous tissue, cartilage, or bone, and the cells of these tissues are strictly comparable. The

FIG. 310.—Tuberculous disease of the os calcis with calcification of caseous abscess. Sinuses formed, secondary infection supervened, and areas of ossification developed. When the amorphous calcium drained away, the bone remained as sequestra and the sinuses persisted until they were removed. (*North Wales Sanatorium case.*)

bone cell of Purkinje is a fibroblast imprisoned in bone and in a state of quiescence. The osteoblast is a fibroblast enlarged because it is active. Any of these tissues, after preliminary de-differentiation to the state of primitive mesenchyme, may be built up again in the form of one of the other tissues. When the endocrine balance is disturbed as in hyperparathyroidism skeletal bone may be de-differentiated only to reappear as fibrous tissue. On the other hand, in myositis ossificans progressiva the fibrous tissue of tendons

and muscles is de-differentiated and built up again as bone. The change from cartilage to bone is seen in every epiphysial disc, and under pathological conditions the same process may be observed in the semilunar cartilages of the knee-joint (*see Fig.* 340). The view put forward by Leriche and Policard,[8] and advocated in this country by Greig,[10] is that the only factor necessary to determine bone as the ultimate destiny of a mass of primitive mesenchyme is an excess of calcium with an adequate blood-supply. By these factors the theory accounts for the development of bone not only in the skeleton but in abdominal scars, thoracic viscera, and other tissues. Any adult tissue which can be de-differentiated into primitive mesenchyme may be built up again as bone if there is calcium excess. Pathological calcareous deposits in any region of the body may therefore change into pathological ossific deposits if the blood-supply should become adequate (*Fig.* 310).

The Physico-chemical Mechanism of Calcification. — The mechanism of the deposition of calcium in these mesenchymatous tissues is obviously a physico-chemical problem. It is probable that the calcium is not separately precipitated in the form of calcium carbonate, calcium phosphate, and other salts, but that the bone salt is a complex calcium carbonato-phosphate molecule [e.g., $Ca_3 (PO_4)_2 CaCO_3$] holding in combination magnesium, sodium, potassium, chloride, fluoride, and hydroxyl groups.[11–17] In addition to inorganic phosphate, blood contains a phosphoric ester the calcium salt of which is soluble. This ester cannot yield PO_4 ions on dissociation, so that it does not affect the saturation of the calcium phosphate.

Robison[18] has shown that tissues which normally become the site of calcareous deposit contain an enzyme, phosphatase, which hydrolyses the ester and sets free inorganic phosphate. The increased concentration of PO_4 ions results in the precipitation of the carbonato-phosphate molecule. In a growing bone the epiphysial line has the greatest phosphatase activity, the already developed bone has a lower activity, and the resting epiphysial cartilage is completely inactive. The patella of a child before the appearance of the centre of ossification has no phosphatase, but so soon as ossification commences phosphatase is to be found. The phosphatase activity of tissues which become the site of pathological calcification has not yet been estimated except in the case of the kidney. But in cases of heterotopic ossification of the abdominal wall, experimentally induced in dogs by transplanting bladder epithelium, Huggins[22] has shown that the ossifying tissue possesses very high phosphatase activity.

The activity of the enzyme is dependent on the hydrogen-ion concentration of the tissue fluids, and in the case of another phosphatase present in blood-corpuscles Martland[24] has shown that there is a delicate equilibrium. If the pH falls below 7·3, the esters are hydrolysed and the inorganic phosphates increase, whereas if the pH is above 7·35, the esters are synthesized and the inorganic phosphates decrease. Moreover, the hydrolysis of phosphoric esters will not necessarily be followed by calcification unless the concentration of calcium ions is also favourable. The kidney has a high phosphatase activity, but with blood calcium at the normal level of 10 mgrm. per cent no calcification is observed. In the presence of hypercalcæmia, calcification of the kidney is very frequently seen (*see Fig.* 324).

Pathological Calcification. — The deposition of calcium salts in mesenchymatous tissues would therefore appear to depend on the concentration of calcium ions and the activity of the phosphatases. The first factor is of significance in relation to the multiple calcareous deposits which may be associated with hypercalcæmia. This association was noted by Virchow and has been observed many times in recent experimental work with parathyroid extract.[25-30] Blood may not be a supersaturated solution of the bone salt,

FIG. 311.—Calcification of caseous psoas abscess in a case of tuberculous disease of the spine. (*Shropshire Orthopædic Hospital case.*)

but normally it is almost fully saturated. In hyperparathyroidism the serum concentration of calcium is increased by 50 per cent or more, and this would reasonably be expected to result in generalized precipitation in many tissues.

But supersaturation will not explain the ordinary case of pathological calcification where there is no evidence of hypercalcæmia. The factors governing phosphatase activity are not yet fully established, but there can

FIG. 312.—Calcification of fibroma of the tibialis anticus. (*Mr. C. Thurstan Holland.*)

FIG. 313.—Calcification of hydatid cyst of liver distinguished from renal calcification by uroselectan.

be no doubt that the local circulation must play an important part, whether through its effect on the carbon dioxide content of the tissues, the hydrogen-ion concentration, or on other undetermined factors. Pathological calcification is seen in tissues of which the metabolism is normally low—in the avascular caseous masses of old tuberculous and syphilitic disease (*Fig.* 311), in tendons and ligaments,[111] in the falx cerebri and the fascia lata, in costal cartilages,[31] the semilunar cartilages,[148] and the intervertebral discs,[133] and in the fibrous walls of blood-vessels. Even in such relatively avascular tissues the deposition of calcium is usually the result of still further reduction in the metabolic rate by fibrosis following trauma or infection. In the tendo Achillis calcification follows the fibrosis of subcutaneous tenotomy (p. 491), and in the supraspinatus tendon it follows chronic traumatic tendonitis (p. 484). In the pericardium calcification is seen after fibrous pericarditis, and in the falx cerebri after sinusitis. The calcification of tumours is observed when the blood-supply is so impaired that degenerative changes have appeared. It is therefore seen in the uterine fibroid, the fibroma of tendons[46] (*Fig.* 312), and in the fibrous walls of cysts (*Fig.* 313).

Whatever may be the association between impaired vascularity, phosphatase activity, and calcification, it is definitely reversible. Tissues may be calcified, decalcified, and recalcified by alternately decreasing the circulation through the influence of X rays and allowing it to increase by a cessation of treatment (p. 469). Moreover, pathological calcareous deposits resulting from reduced vascularity of the tissues, may reabsorb in the presence of secondary irritative hyperæmia (p. 485). If the deposit of calcium is sufficiently extensive, revascularization will result in ossification; but with smaller deposits, revascularization leads to complete reabsorption.

The Relation of Vascularity to Calcification of Bone.—There can be little doubt that the same factors govern the calcification of all mesenchymatous tissues, and the same relationship of vascularity to calcification which is observed in pathological deposits is also observed in bone. If the blood-supply to a bone is decreased, the bone undergoes increased calcification; if the blood-supply is increased, the bone undergoes decalcification.

Diminution of the arterial blood-supply of bone is constantly seen in syphilitic osteitis where there is endarteritis obliterans, and the characteristic bone change is one of increased calcification or sclerosis. Similarly increased calcification is observed in the later stages of osteomyelitis, when the initial hyperæmia has subsided and has been replaced by the ischæmia of reparative fibrosis.

The hyperæmia which causes decalcification may be infective in origin, it may be traumatic and due to the liberation of the vasodilators histamine and acetylcholine, or it may be of the nature of a relative hyperæmia from disuse. There appears at first sight to be some difficulty in correlating the decalcification of injury and infection, where obviously there is hyperæmia, with the decalcification of disuse. In the first place it must be recognized that disuse rarely stands alone, and as a rule there is the added factor either of injury or of infection. In a paralytic limb where there is uncomplicated disuse, decalcification is of relatively mild degree. Moreover, even in such a case, although there is total functional inactivity, there is relatively little

impairment of arterial supply, and a blood-supply which is normal for a limb in normal activity becomes a relative hyperæmia when the limb is totally inactive. The degree of decalcification is therefore proportionate to the intensity of the hyperæmia. It is least marked and develops most slowly from the relative hyperæmia of disuse, it is more severe with the greater hyperæmia of trauma, and it is most complete with the acute hyperæmia of infection.

A fact which is obvious, but which requires emphasis owing to the importance of its clinical applications, is that a fragment of bone completely cut off from the circulation so that it is avascular, will retain its original calcium content unchanged, whatever changes may occur in the adjacent vascular bone.

Résumé.— The pathological and biochemical observations which have been discussed and which are of clinical importance may be summarized as follows :—

1. There is normally a balance between the calcium content and the vascularity of mesenchymatous tissues (which is probably associated with phosphatase activity).

a. In the case of bone.—

Normal circulation ——→ Normal calcification
Increased blood-supply ——→ Decalcification
Decreased blood-supply ——→ Increased calcification
Blood-supply cut off ——→ Unchanged calcification

b. In any mesenchymatous tissue of low metabolism.—

Decreased blood-supply ——→ Pathological calcification.
(Fibrosis of trauma or infection)

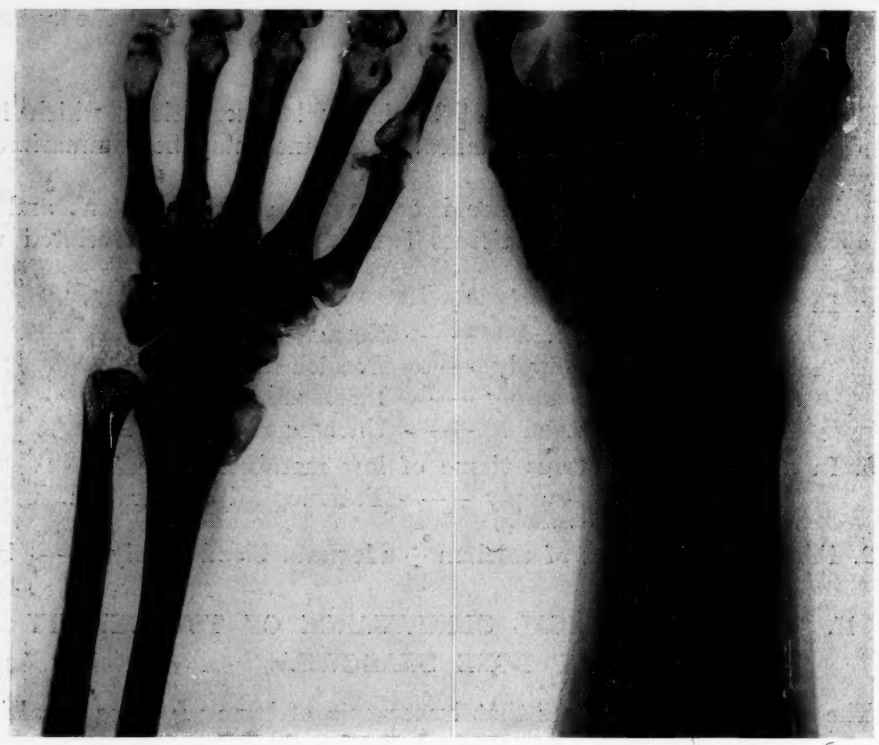
2. Fibroblasts + excess of calcium + adequate blood-supply ——→ bone.

II. THE RADIOLOGICAL SIGNIFICANCE OF THE DENSITY OF BONE SHADOWS.

The pathologist recognizes that hyperæmia of bone produces decalcification, and anæmia produces sclerosis; the radiologist recognizes the converse, and must interpret decalcification as evidence of an increased blood-supply and sclerosis as evidence of a decreased blood-supply.

Disuse decalcification affects the whole of the bones of the limb equally, except that the vascular cancellous bone will obviously be more involved than the compact bone. The degree of decalcification may be taken as an accurate index of the functional use or disuse of the limb. *Fig.* 314 shows two identical cases of Colles's fracture of the radius. The first has been immobilized by splints which have seriously interfered with the functional use of the limb. The second has been immobilized just as completely, but by means of a plaster cast which has left free the fingers and the palm of the hand. In the second case work has been continued throughout, so that there has been no diminution in muscular activity despite the immobilization of the joint. The first shows marked decalcification and the second shows none.

Very complete decalcification may be seen in the presence of infection of neighbouring parts, but it is important to recognize that the loss of calcium in such cases may be due entirely to hyperæmia, and does not necessarily imply any infection of the bone itself. In a recent case of tuberculous tenosynovitis of the tibialis posticus, there was such marked localized decalcification of the metaphysis and epiphysis of the tibia that the diagnosis of osteomyelitis seemed fully justified. But when the tuberculous sheath was excised the bone was found to be uninfected. Although it was decalcified and cut easily with a scalpel, there was neither inflammatory nor destructive change.



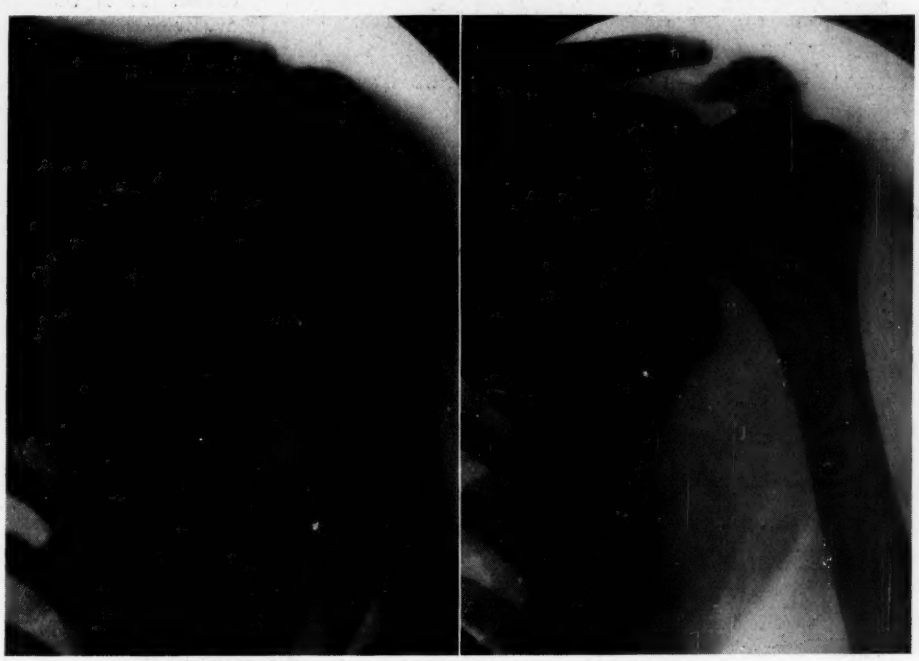
A B

FIG. 314.—Disuse decalcification of bone. Two similar cases of Colles's fracture of the radius eight weeks after injury. A, In this case there has been excessive splintage and no functional activity. B, In this there has been full functional activity throughout.

In tuberculosis of the hip-joint, radiological examination in the active stage of the disease may suggest complete destruction of the femoral head. Nevertheless subsequent X-rays taken after quiescence of the infection and the resumption of function, prove that the bone had been merely decalcified. Cases which would otherwise appear to be remarkable examples of bone regeneration are not infrequently observed.

Similarly, in neoplasms of bone it is important to distinguish between destruction and simple decalcification. Bone sarcomata may be osteolytic or osteoplastic in nature. The relationship between vascularity and decalcification is well exemplified in these tumours, for one finds that the osteolytic

type is rapidly growing and very hyperæmic, whereas the osteoplastic type is more slow growing and less vascular. In the former type the increased vascularization is seen not only in the tumour itself but also in neighbouring bony parts. This parasarcomatous hyperæmia would account for the appearance presented in some cases where the bone beyond the limits of the tumour itself is seen to be markedly decalcified. So extensive may be the decalcification that inspection of the radiograph suggests extensive destruction of the bone. In a case of this type (*Fig.* 315) treated by X rays combined with colloidal lead, the bone appeared under treatment to reorganize almost completely. Presumably the diminution in the blood-supply resulting from the treatment gave rise to recalcification of the previously decalcified area.



A B

FIG. 315.—Sarcoma of the scapula showing recalcification under treatment by X rays and colloidal lead. A, Nov. 8, 1923. B, Feb. 4, 1924.

When treatment was suspended, further decalcification took place, with subsequent recalcification when further treatment was given. The patient eventually died from metastases elsewhere.

If in the presence of generalized decalcification one fragment of bone has retained its normal calcium content, the radiologist can say with certainty that the fragment is avascular. It is this fact which enables him to report the presence of a sequestrum in osteomyelitis. But the sequestration of bone may be the result of trauma and not of infection. The carpal scaphoid bone is supplied with blood by a vessel which enters at the tubercle, and a fracture through the waist of the scaphoid will completely cut off the blood-supply of the proximal half of the bone. In such a case, although every other carpal

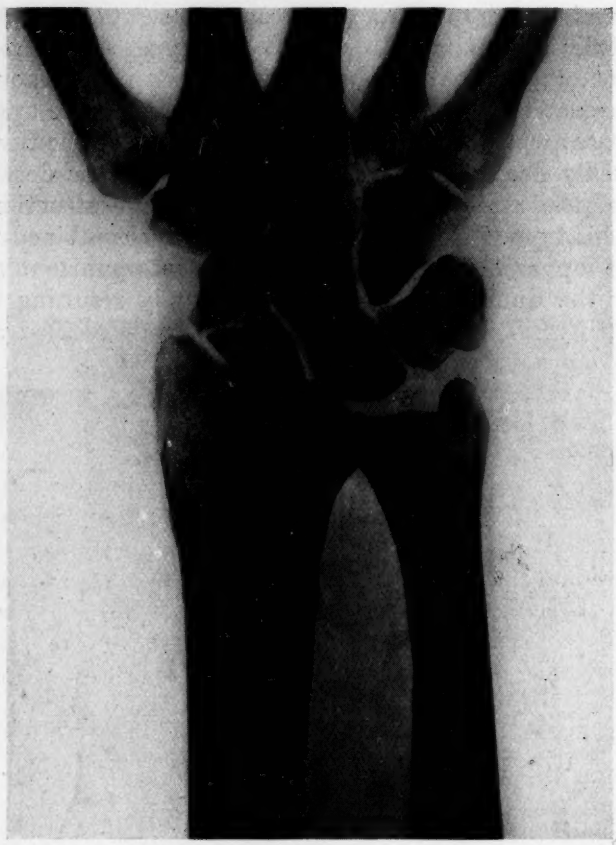


FIG. 316.

FIG. 316.—Fracture of the carpal scaphoid with evidence of avascularity of the proximal half of the bone. The proximal half of the scaphoid is of normal density (cf. upper shafts of radius and ulna). Unlike the distal half and the other carpal and metacarpal bones, it has not undergone decalcification. It is therefore avascular.

FIG. 317.—Fracture of the neck of the astragalus and of the internal malleolus. The body of the astragalus and the internal malleolus having retained their full calcium content must be avascular. This implies that there has been dislocation of the body of the astragalus which is now reduced.

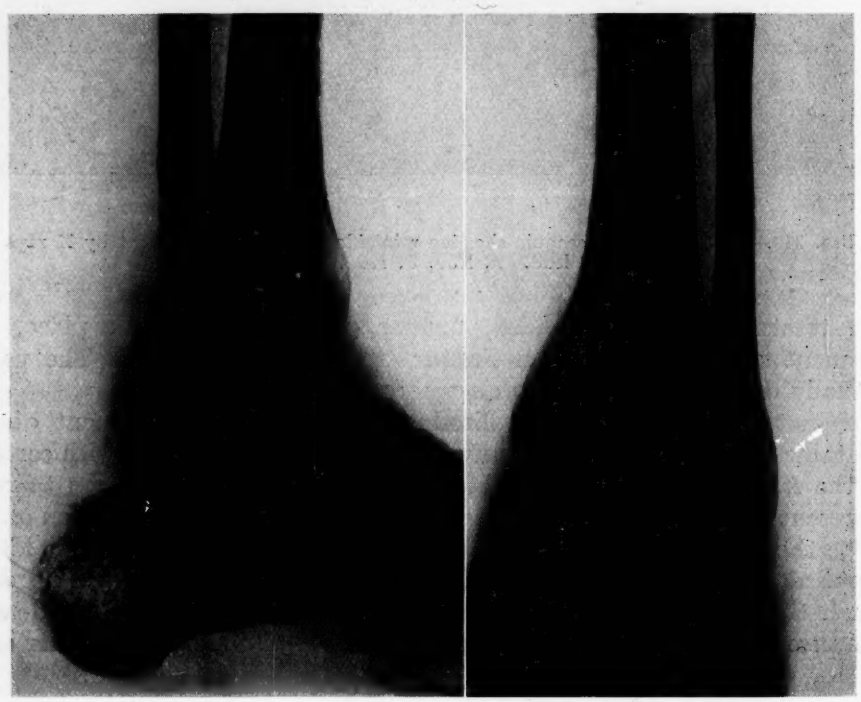


FIG. 317.

bone may decalcify, the proximal half of the scaphoid remains normally dense (*Fig.* 316). If in another case there is normal density of the semilunar as well as of the proximal half of the scaphoid, the other bones being decalcified, the radiologist can say with certainty that there has been a dislocation of the semilunar and half scaphoid, although the dislocation may now be reduced. Similarly, if the astragalus shows normal density but every other adjacent bone shows decalcification, the radiologist knows that the astragalus is avascular and that it has been completely dislocated and its ligamentous attachments torn, although the bone may subsequently have been replaced (*Fig.* 317).

III. THE CLINICAL SIGNIFICANCE OF HYPERÆMIC DECALCIFICATION OF BONE.

Delayed Union of Fractures.—The decalcification of disuse frequently accounts for delay in the consolidation of fractures. It is well recognized that delayed union of leg fractures may be cured by simple weight-bearing in an ambulatory splint or plaster. The treatment has done nothing more than to balance the functional activity of the limb with the arterial blood-supply, so preventing further disuse decalcification and leading to recalcification. On this pathological fact is based the principle of early functional activity in the treatment of all fractures.[52] It is this fact which explains the greater success of the dorsal plaster cast in securing bony union of fractures of the carpal scaphoid than the palmar cock-up splint which interferes with function.[51]

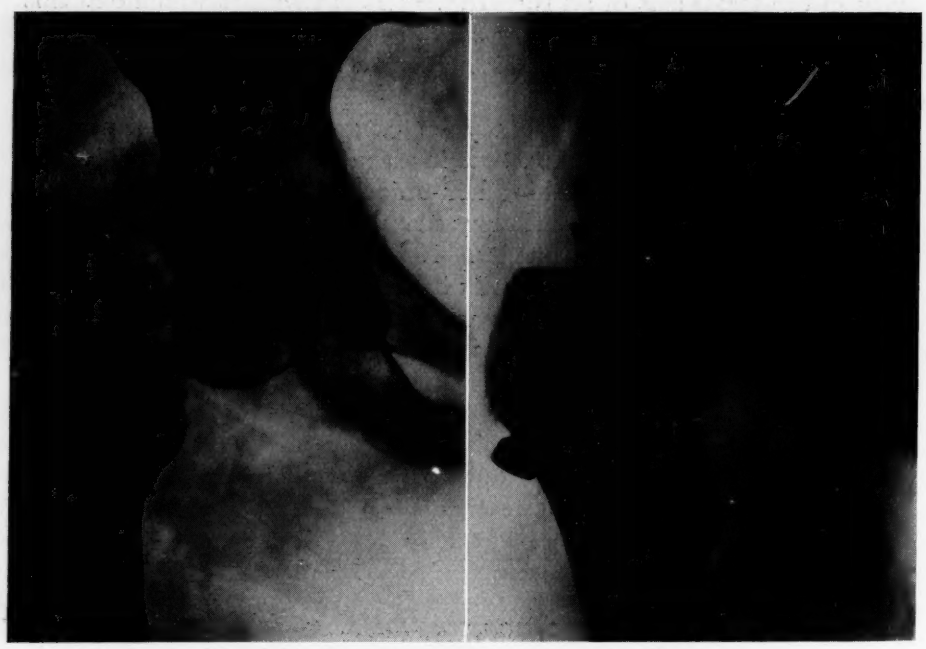
Non-union of Fractures.—It may be categorically laid down, contrary as it may be to existing teaching, that inadequate immobilization is the *only* factor of importance in establishing non-union. Before a fracture can unite, capillary blood-vessels and a continuous mass of young connective tissue must bridge the gap between the fragments. Not until the initial traumatic hyperæmia has subsided can the calcium salts be redeposited in the young connective tissue to form callus. When finally with increasing fibrosis the local blood-supply becomes impaired, the callus joining the two fragments undergoes dense calcification and sclerosis, and union is consolidated.

If, on the other hand, the fragments are imperfectly immobilized, the constant shearing and twisting strains rupture the capillaries between the fragments, and interrupt the continuity of the developing connective tissue. Moreover, the repeated traumatization gives rise to constantly recurring hyperæmia, and more and more of the bone-ends undergoes decalcification. Ultimately a linear fracture is represented by a cavity, the two bone-ends showing concave surfaces. When finally the hyperæmia does subside, there is no continuous mass of callus which can be recalcified, and sclerosis is observed in the plaque of bone across the concave bone-ends. Non-union is now established.

This sequence of events may constantly be seen in fractures of the scaphoid and fractures of the neck of the femur which have been imperfectly immobilized (*Figs.* 318, 319). Moreover, it is of significance that the fractures of the skeleton which have been the most common sites of non-union, are

A B

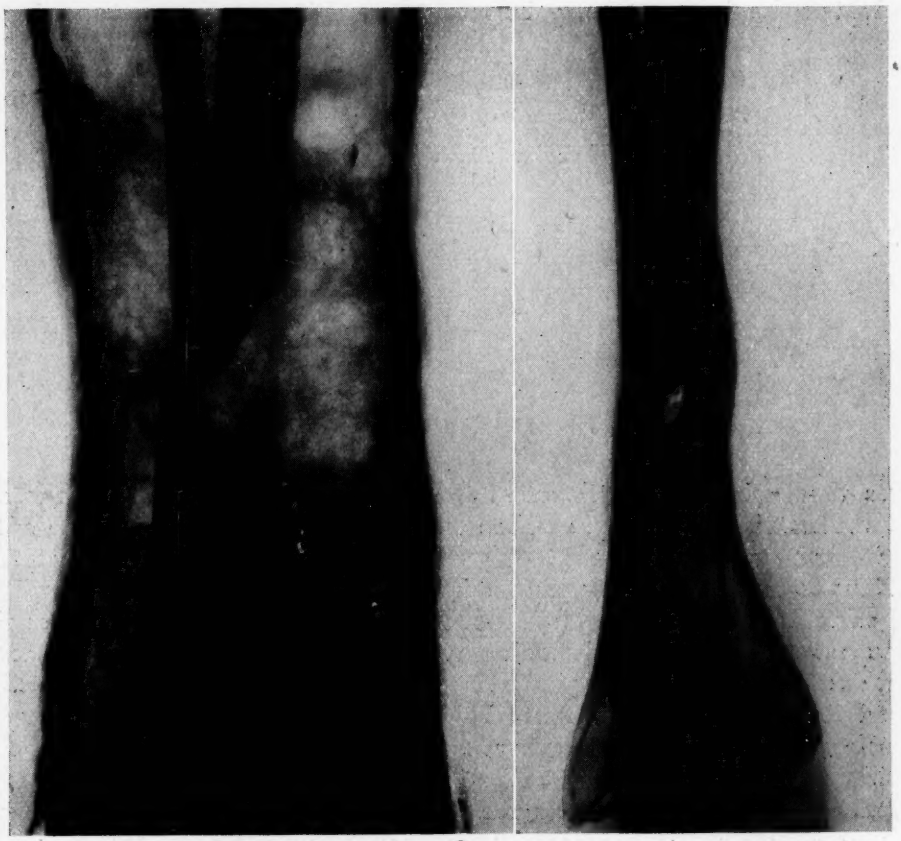
FIG. 318.—A, Ununited fracture of scaphoid of six months' duration. B, By no treatment other than immobilization for many months, the fracture has united by bone; the traumatic hyperæmic decalcification has been arrested and the cavity has recalcified.



A B

FIG. 319.—A, Ununited fracture of femur neck. Six months after injury. The patient has been in bed throughout. The continued traumatic hyperæmia from inadequate immobilization has caused decalcification of the neck. (*Dr. J. H. Mather.*) B, Similar fracture of neck of femur. Six months after injury. This patient has also been in bed moving his limb throughout, but the fracture has been immobilized by a stainless Smith Peterson nail, and no decalcification has occurred.

precisely those which are most difficult to immobilize completely.* Furthermore, in fractures of the true neck of the femur the percentage of cases securing bony union is directly proportional to the completeness of the immobilization. With no immobilization, not one unites by bone; with a Whitman plaster, which immobilizes to some extent but does not completely prevent shearing and rotative strains, about 50 per cent unite; with a Smith



A B

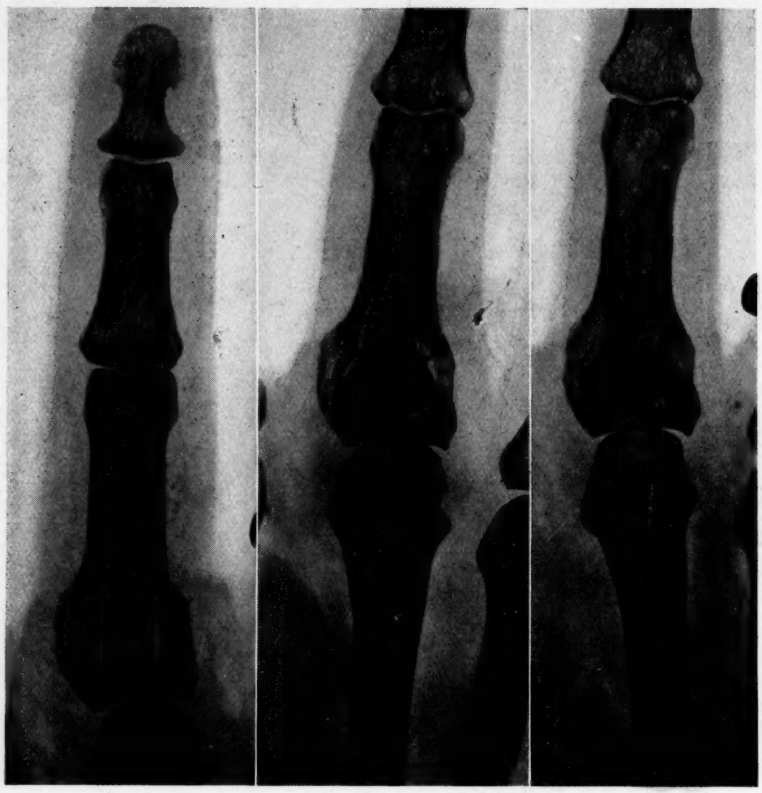
FIG. 320.—A, Compound fracture of shafts of both leg bones treated by Winnett Orr plaster. There is extensive decalcification owing to traumatic and infective hyperæmia. B, Same case ten months later. There has been no treatment other than continued immobilization. As the traumatic and infective hyperæmia subsided the 'cavity' recalcified.

Peterson nail[50] so well placed that immobility is absolute, practically every case unites by bone (*Fig.* 319).

In the infected compound fracture there is still more decalcification, because the initial hyperæmia of trauma is perpetuated by the hyperæmia of

* It should not be necessary to point out the fallacy in the argument that because fractures of the ribs always unite some degree of mobility encourages union. Although the whole rib moves with every respiration, it is a composite movement in which both fragments move together; they do not move on each other. There is no fracture in the skeleton in which there is a greater protection from shearing strain.

infection. But decalcification only delays union and does not prevent it. The explanation of the frequency of non-union in infected fractures lies in the fact that the treatment of the infection has usually been allowed to interfere with the immobilization. The Winnett Orr treatment[53] of compound fractures has helped to solve the difficulty, not only by maintaining absolute immobilization despite the infection, but by minimizing the loss of calcium through minimizing the volume of discharge. When this method of treatment is adopted the fragments may be seen to recalcify as soon as the infection



A B C

FIG. 321.—A, Chondroma of phalanx; B, One month after curettage and bone-grafting; C, Six months after bone-grafting. A month after operation the graft still has a greater density than the adjacent bone. It is therefore avascular and is dead.

becomes quiescent. Consolidation rapidly follows the removal of the last sequestrum and the healing of the last sinus, and even extensive gaps are filled and recalcified without bone-grafting proving necessary (*Fig.* 320).

The Transplantation of Bone.—When non-union of a fracture has become established with cavitation and with sclerosis of the bone-ends, a bone-grafting operation undoubtedly facilitates union. There has been considerable difference of opinion amongst surgeons as to whether the cells of the graft survive, or whether the graft dies and merely provides a framework for new bone formation. During the first day or two the undamaged cells on the surface

of the graft may perhaps grow and multiply, for even in the laboratory, with suitable hanging drop media, Fell[55-59] has grown living cultures of bone. Nevertheless active growth of the graft cannot continue after the first few hours unless there is survival of its cells by revascularization. Radiographs taken at frequent intervals after operation show that the graft, so long as it remains visible in the films, has a greater density than the adjacent bone, which undergoes the decalcification of traumatic hyperæmia (*Fig.* 321). This in itself proves that the graft has remained avascular, and although its calcium store is utilized by continued surface erosion until it is entirely absorbed, the transplanted bone has never been within the circulation of its host.

A bone-grafting operation facilitates union of fractures in three ways: (1) The preparation of the bed of the graft breaks down the barrier of sclerosed bone and allows revascularization and mobilization of calcium salts; (2) The graft itself augments the local excess of calcium; and (3) The accurate fitting of the graft in its bed assists in securing the necessary immobilization. These three factors also apply when the bone-grafting operation is complicated by infection, and it is entirely wrong in these circumstances to remove the graft at an early stage. The transplanted bone is no more dead than in uninfected cases, and, provided that immobility is unceasingly maintained by a Winnett Orr plaster, the calcium salts liberated by the infective hyperæmia are utilized for the recalcification of the callus. In every sequestrum there is evidence of decalcification in the erosion and pitting of the surface. The only difference between a bone-graft and a sequestrum is that in the former case the fragment is completely decalcified by the vascular young connective tissue, whereas in the latter case decalcification is ultimately limited by the fibrosis and avascular scar-tissue formation of the later stages of infection. When once the infection has reached this chronic stage the graft can be of no further assistance, for it cannot be further decalcified, and any fragments responsible for sinus formation may be removed. But in a definite proportion of cases sufficient calcium has already been mobilized and the fracture is united.

The Robertson Lavalle operation[60-70] of drilling into the decalcified areas adjacent to the surface of a tuberculous joint and laying a fragment of bone in the drill hole is merely another illustration of the value of a transplanted fragment of bone as a source of calcium salts. The operation cannot be of value through the hyperæmia it induces, for the decalcification proves that the region is already hyperæmic. The 'regeneration' which is claimed is merely recalcification of bone which has not been destroyed but has been decalcified by hyperæmia.

In the obliteration of bone cysts and benign tumours of bone the implantation of a graft is a procedure which facilitates bone regeneration by providing a reservoir of calcium (*see Fig.* 321), and there is evidence that boiled bone, beef bone, ivory, or a paste of calcium salts is equally effective.

Kümmell's Disease.—If it be accepted that Kümmell's disease of the spine,[71, 72] with absorption of the vertebral body progressing weeks and months after injury, can occur in the absence of any fracture, it is to the

hyperæmic decalcification of contusion of the vertebra that the condition must be ascribed. One of the authors has shown elsewhere[73, 74] that extensive crush fractures can be spontaneously reduced by simple hyperextension movement, and even perfect X-rays may fail to show evidence of the fracture which earlier X-rays proved to be present. In such cases there will undoubtedly be hyperæmia of the vertebral body, and it is not necessary to assume a rather problematical 'contusion' localized to one body. In every fracture of the vertebral body the resulting hyperæmia leads to decalcification and absorption. This still further facilitates the collapse and wedging of the vertebra which follows the breaking up of the cancellous framework unless it

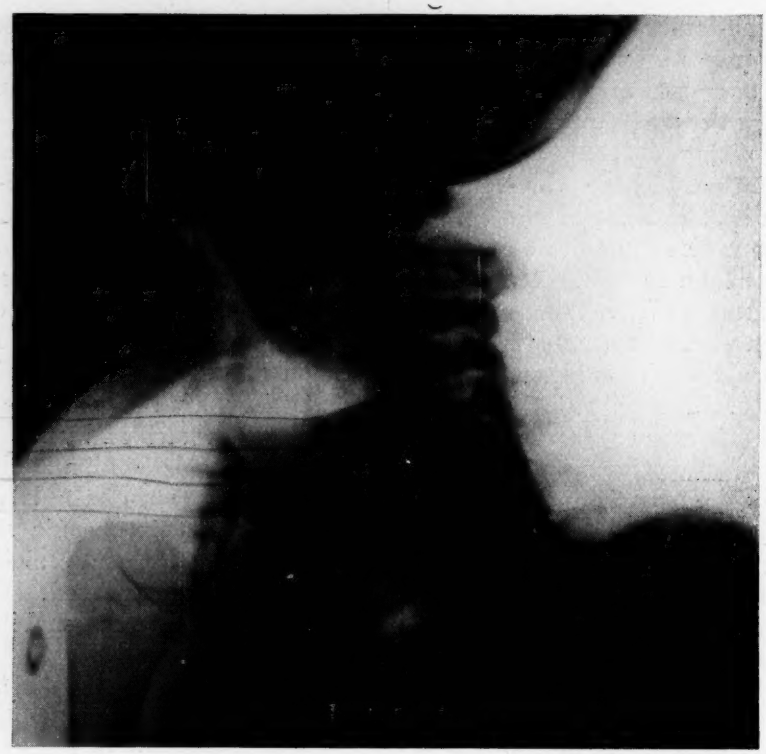


FIG. 322.—Spontaneous hyperæmic dislocation of the atlas with cord pressure and quadriplegia. The dislocation was reduced, the child survived, and the paraplegia recovered. Two years later there was pyuria and tubercle bacilluria, but there has been no evidence, radiological or clinical, of tuberculous disease of the atlas. (*Dr. Emrys Jones.*)

is adequately protected. For this reason the deformity after a relatively simple untreated crush fracture of the spine never attains its maximum until several months after injury.

Spontaneous Hyperæmic Dislocation of the Atlas.—It has been pointed out that hyperæmic decalcification of bone does not necessarily imply infection of the bone itself, but may result from the spreading hyperæmia of an adjacent inflammatory focus. This is most clearly illustrated by the disastrous consequences of nasopharyngeal infections and other infections at the base of the skull, when the hyperæmia extends sufficiently to involve the atlas.

So marked may be the decalcification that the attachments of the transverse ligament are loosened and the anchorage of the odontoid to the atlas is impaired. Forward subluxation or dislocation of the atlas may now arise spontaneously.

The 14 recorded cases and 2 personal cases were recently reviewed by one of the authors,[82] and since that publication 4 further cases have been observed by him, and others personally communicated, bringing the total to 21. The condition occurs most commonly at the end of the first decade. The nature of the infection and its exact location is of no significance; it may be tuberculous, specific, or pyogenic; it may involve the tonsil, the nasopharynx, the cervical glands, the retropharyngeal cellular tissue, the mastoid process, or the occipital bone. The one factor common to all cases has been an infection sufficiently acute and sufficiently near the atlas to give rise to hyperæmia but not necessarily to infection of the bone. In the majority of cases the dislocation has been readily reduced and a relatively short period of immobilization has been adequate in securing complete recovery.

FIG. 323.—Spontaneous hyperæmic dislocation of the atlas with cord pressure and death. There is hyperæmic decalcification of the odontoid but no evidence of tuberculous disease. (*Post-mortem Specimen, Liverpool University Pathological Museum.*)

Three clinical types must be distinguished, the pathology being identical in all types and the clinical differentiation dependent upon the degree of displacement. In the group which is the most common, the atlas is dislocated forwards and slightly rotated, sufficiently to produce torticollis, painful movement, and spasm of the deep cervical muscles. In the second group, of which no case has hitherto been reported in the literature, the displacement is more marked and the spinal cord is compressed; the compression is incomplete so that the patient survives, but a quadriplegia results—in the case now reported the dislocation was reduced and the paralysis fully recovered (*Fig.* 322). In the third group the dislocation is so complete that the cervical cord is completely compressed and the patient dies suddenly; the cases of Greig and of Reid are of this type, and *Fig.* 323 shows the post-mortem specimen of a similar case in the Liverpool University Museum.

SUMMARY OF 21 CASES OF SPONTANEOUS HYPERÆMIC DISLOCATION OF THE ATLAS.

AUTHOR	AGE	SEX	CAUSE OF HYPERÆMIA
Dislocation without Complication:—			
Gillette[75]	2	?	Tonsillitis
Swanberg[76]	22	M.	Tonsillitis
Grisel[77]	8	F.	Tonsillitis
Grisel	9	F.	Nasopharyngitis
Desfosses[78]	7	F.	Nasopharyngitis
Berkheiser[79]	8	F.	?
Berkheiser	10	F.	Scarlet fever (? with pharyngitis)
Berkheiser	9	M.	'Cold in head'
Berkheiser	11	M.	'Sore throat'
Berkheiser	9	F.	Acute influenza
Watson Jones[82]	9	M.	Acute mastoid disease
Watson Jones	2	M.	Nasopharyngitis
Watson Jones*	17	M.	Osteomyelitis of occipital bone
Watson Jones*	11	F.	Pharyngitis and bronchitis
Fitzwilliams*	10	M.	Tonsillitis and cervical adenitis
Fitzwilliams*	15	M.	? Acute rheumatism
Dislocation with Quadriplegia:—			
Watson Jones*	7	M.	T.B. cervical glands
Dislocation with Sudden Death:—			
Chas. Bell[80]	?	F.	Syphilitic ulceration of pharynx
Greig[81]	16	F.	Retropharyngeal abscess
Reid	16	F.	T.B. cervical glands
Watson Jones*	History unknown		

* Not previously recorded.

Recumbency, Decalcification, and Nephrolithiasis.—Patients whose treatment demands prolonged recumbency and immobility frequently develop large numbers of calculi in the renal pelvis and ureter. So common is the complication and so extensive the calculus formation that the possibility of coincidence is excluded. Very frequently it is observed in open-air hospitals where cases of tuberculosis of the spine or of the hip-joint are immobilized for many months by spinal frames. But it is not confined to sanatorium patients, and cannot be explained by the hypervitaminosis of heliotherapy. Moreover, it is not confined to tuberculous patients, and even when there is tuberculous disease of bone there is no evidence of similar infection of the kidney. It may occur after fractures of the neck of the femur, and was seen in military hospitals in cases of gunshot wound with infected fracture of the thigh.[83–89] Furthermore, calculi sometimes develop within some months of a severe debilitating disease such as pneumonia or empyema, where there is no primary bony abnormality.

The factor common to all cases is recumbency and general immobility. We have shown that immobility causes local decalcification of the bones, and the evidence of X rays shows that generalized disuse depletes the calcium store of the whole skeleton. Moreover, in the majority of cases, to the general decalcification of disuse is added the local decalcification of the disease. We know that the kidney has a high phosphatase activity, and in all of these

FIG. 324.—Nephrolithiasis following hypercalcæmia of hyperparathyroidism.
(*Dr. Baker Bates and Dr. R. W. Gemmell.*)

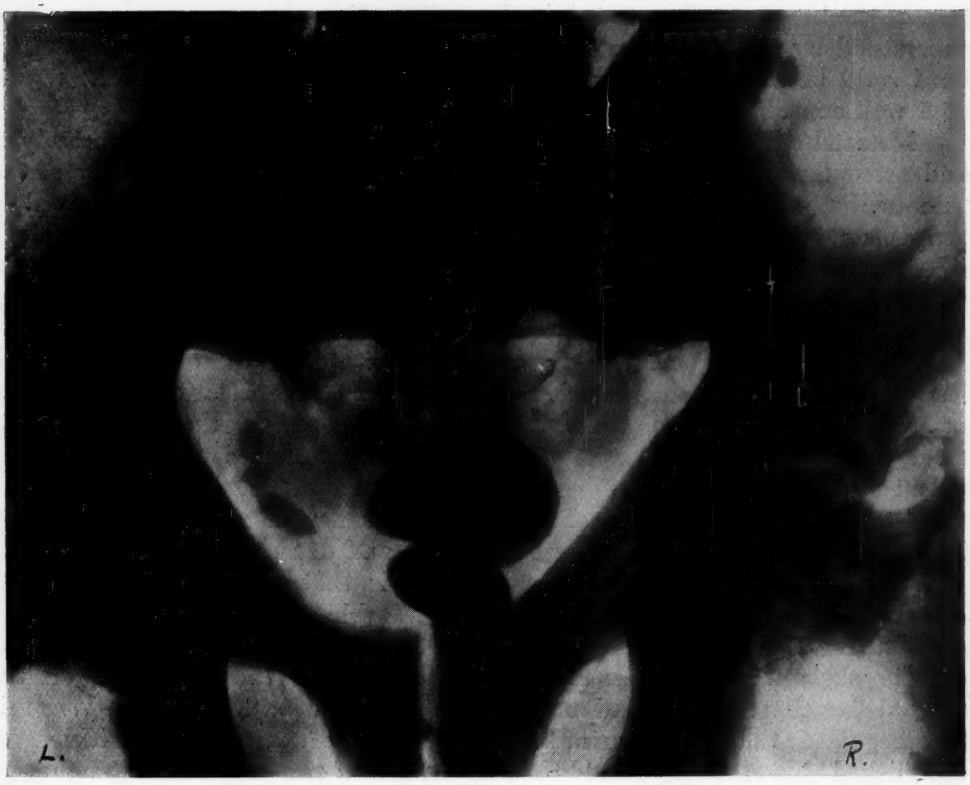


FIG. 325.—Vesical calculi in Paget's disease.

cases the deposit suggests the precipitation of soluble salts through supersaturation, for not uncommonly the calculi disappear when activity is resumed. There would appear, therefore, to be little doubt that the nephrolithiasis is the result of skeletal decalcification and is comparable with the nephrolithiasis of hyperparathyroidism (*Fig.* 324). Amorphous vesical calculus formation in Paget's disease (*Fig.* 325) may be accepted as a similar type of calcium deposition in the urinary tract.

Despite the fact that the calculi may disappear with the resumption of activity, the dangers of this complication are not to be under-estimated. Quite apart from the risk of renal inefficiency due to obstruction, the prolonged excessive excretion of calcium in itself may lead to renal cellular degeneration and retention of non-protein nitrogen.[20] Frame patients should be taught regular exercises for those parts which need not be immobilized, the extent and duration of immobility should be minimized as far as possible, and the fluid intake should be increased throughout the period of recumbent treatment.

IV. THE CLINICAL SIGNIFICANCE OF ISCHÆMIC CALCIFICATION OF BONE.

The recovery of bone infections and the repair of bony injuries are characterized pathologically by fibrosis and scar-tissue formation with diminution of the blood-supply. The initial decalcification of hyperæmia is therefore superseded by the recalcification and sclerosis of reduced blood-supply. The hard solid bones of chronic osteomyelitis and the dense bone in the region of a well consolidated fracture are evidence of this.

Metastatic Malignant Disease of Bone.—The distinction between osteolytic and osteoplastic types of bone sarcoma, depending on the vascularity of the tumour, has already been discussed. Similar differences may be observed in the secondary bone deposits of carcinomata, and the most striking example is seen in the secondaries of carcinoma of the prostate. These diffuse deposits grow slowly, and are relatively avascular, with none of the power of invoking multiplication of neighbouring capillaries such as is constantly seen in the sarcomata. Unlike the rapidly growing deposits of breast carcinoma which lead to focal destruction, there is a slow and gradual infiltration of the whole of a vertebral body so that the vascular cancellous bone is replaced by relatively avascular osteoid tissue which ultimately becomes the site of dense calcification.

The Fragility of Calcified Bone.—The frequency of spontaneous fracture in bone which is apparently sclerosed, hard, and dense has not been capable of easy explanation. The significant point is that a dense X-ray shadow does not necessarily imply a hard bone. Marble and chalk cast a shadow of similar density,[102] but the fragility is very different. The resistance of the skeletal framework to injury depends on the resilience of the normal lamellated bone and not on the degree of calcification. When it is recognized that the increased laying down of calcium is evidence of diminished blood-supply and reduced vitality, the abnormal fragility is readily understood.

In Paget's disease, one of the authors has shown[90] that fractures due to trivial injury are seen in the earlier stages of fibrous metaplasia where the bone shows granular calcification. They are not encountered in the later stages where calcification has progressed to re-ossification in the form of well-defined lamellæ or strands of new bone.

Fig. 326.—Charcot's disease of the ankle with involvement of the os calcis. Although there is increased calcification of the os calcis, the bone is abnormally fragile and has bent beneath the body weight.

In syphilitic osteitis where there is endarteritis obliterans the characteristic bone change is sclerosis with an abnormally dense X-ray shadow. *Fig.* 326 is from a case of Charcot's disease of the ankle, and there is evidence of osteitis of the os calcis. The bone is abnormally dense and there is increased calcification, but it is soft and has bent beneath the body weight. The angle of the bone is lost, exactly as it is in crush fractures of the os calcis due to a fall on the heel.

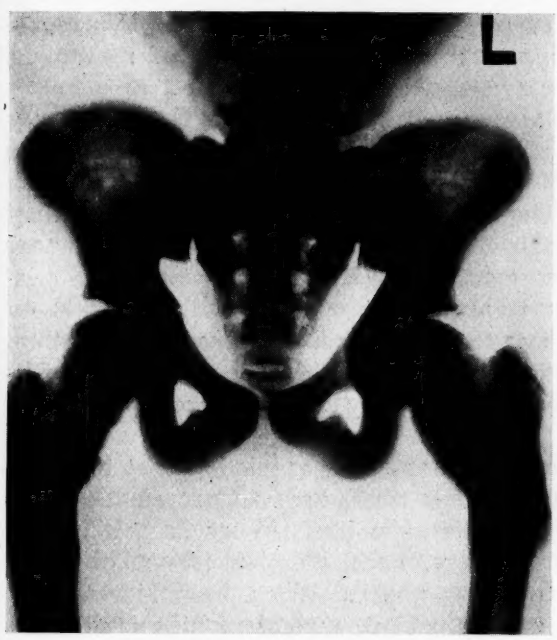


Fig. 327.—Osteosclerosis fragilis generalizata (Albers-Schönberg's disease). Fractures have occurred in the femora where the calcification is greatest. The bone is abnormally fragile. Note the rings of calcified bone in the pelvis parallel with the epiphysial lines.

It is in the rare disease osteosclerosis fragilis generalizata, first described by Albers-Schönberg,[91–102] that the association of increased calcification with fragility is most conspicuous. The term 'marble bones' which has been applied to the disease is misleading. 'Chalky bones' would be a more accurate description, for, despite their apparent density, the bones are relatively soft, easily drilled, and liable to spontaneous fracture. In one case which has been under investigation (*Fig.* 327) every epiphysis is involved and the disorder was apparent from an early age. There is evidence of periodicity of the disease in the rings of

sclerosed bone alternating with rings of more normal bone lying parallel with the epiphysial lines and particularly evident in the pelvis. As yet no evidence of general vitamin or endocrine disturbance has been found, it has not been possible to estimate the phosphatase activity of an epiphysis, and the factors responsible for the epiphysial abnormality are not known. But whatever future investigations may show, it is significant that fractures occur in those regions of the bone which are most densely calcified.

Kienböck's Disease and Preiser's Disease (*Traumatic Sclerosis and Porosis of the Carpus*).—In 1910 Preiser[103] described five cases of wrist injury where an oval or circular area of decalcification appeared in the waist of the scaphoid, leading later to the appearance of a fracture through the decalcified area. Preiser believed that the fracture did not precede the decalcification, but that it was pathological in type, occurring spontaneously as its result. Haenisch[104] showed, however, that in Preiser's original films there was usually evidence of a fissured fracture through the waist of the bone. The frequency of crack fracture of the scaphoid is much greater than is usually recognized, but the injury is easily overlooked in radiographs. The fracture is frequently in an oblique plane which coincides neither with the antero-posterior nor with the lateral planes of the wrist. Radiographs taken accurately in these axes may show no evidence of it, although it is clearly visible in a 'three-quarter' oblique view. A slight break in continuity of the articular surface may be the only manifestation, and the magnification of a lens may be necessary to pick out the line of fracture running across the bone. In some cases a fissured fracture of the scaphoid is suspected, but only proved by taking further radiographs after an interval of two or three weeks, by which time hyperæmic decalcification of the fragments due to the continued trauma of movement has made the injury obvious.

In every case of fracture of the scaphoid, however slight the crack may appear to be, progressive decalcification is observed unless the fragments are immobilized, and it is the progressive nature of the decalcification which proves the pre-existing fracture. The local areas of decalcification which may be observed in any carpal bone following a contusion or a ligamentous tear rapidly disappear as function is resumed. Only if the initial trauma is perpetuated by the repeated trauma of movement of fractured fragments on each other, does the decalcification progress. 'Preiser's disease', therefore, is not a clinical entity; it is a fracture of the scaphoid inadequately immobilized. The so-called 'cyst of the scaphoid' is merely a stage in the development of an ununited fracture.

If at any time an unpadded dorsal plaster cast is applied so that the bone is immobilized while functional activity is continued, the rarefaction disappears, the bone recalcifies, and the fracture unites. When immobilization is instituted immediately after the injury, decalcification is not observed and the fracture unites in six to eight weeks. When immobilization is delayed until after the fragments are decalcified, several months of fixation may be necessary (*see Fig.* 318). In either event the wrist becomes radiologically and clinically indistinguishable from normal. There is no kind of justification for excision of the bone as advocated by Hirsch,[106] and physiotherapy as suggested by Buchman[107] will obviously increase the hyperæmia,

accelerate the decalcification, render non-union inevitable, and account for the osteo-arthritis of the wrist which he describes as the usual end-result of conservative treatment.

If the wrist is not immobilized, the constantly repeated trauma leads ultimately to reparative fibrosis with impairment of the blood-supply, and an area of sclerosis is observed round the margin of the decalcified zone. Whereas decalcification is the response of bone to the immediate hyperæmia of a single injury, increased calcification is the response of bone to the delayed ischæmia of constantly repeated injury. Herein lies the explanation of Kienböck's disease of the semilunar.[105] The condition is not a complication of fracture or dislocation of the semilunar.* It is not seen after a single wrist injury, but occurs most commonly in the right wrist of miners, gardeners, and other labouring men who sustain frequently repeated occupational contusions of the joint. The semilunar occupies the key position of the carpal arch and is constantly subjected to compression forces. The immediate effect of these minor injuries is seen occasionally in small areas of traumatic hyperæmic decalcification; the cumulative delayed effect is seen in the ischæmic sclerosis of the bone known as Kienböck's disease. When the bone is removed it is found to be relatively bloodless, fragile, and mis-shapen. Microscopical examination shows areas of fibrosis and general necrosis of the bone.

In considering treatment it must be recognized that Kienböck's disease represents the end-result of a long-standing pathological process, and symptoms are due not merely to necrosis of the bone but to mechanical derangement of the joint owing to alteration in the shape of its articular surfaces. As would be expected, prolonged immobilization has no effect whatever on the sclerosis of the bone. Physiotherapeutic treatment and operative drilling of the bone with the object of revascularizing it have been attempted but without amelioration of the symptoms. The only prospect of relief is by excision of the bone, and although no wrist from which the semilunar has been removed recovers normal movement or strength, the joint becomes sufficiently stable and painless to enable moderately heavy work to be resumed.

Köhler's and Freiberg's Disease of the Metatarsal.—Köhler's disease of the metatarsal[108] (Panner's or Freiberg's disease) is exactly analogous to Kienböck's disease of the semilunar. There is evidence of impairment of the blood-supply not only in the increased density of the bone, but in the fragmentation and distortion of the metatarsal head which results in arthritic change in the metatarso-phalangeal joint. Excision of the head of the bone relieves the symptoms, and histological examination of the bone shows definite evidence of fibrosis and necrosis, confirming the fact that impairment of blood-supply is the underlying cause. The factors responsible for the interference with blood-supply are not yet clearly established, although the frequent association of the condition with congenital anomalies of the first metatarsal which increase the weight-bearing strain on the affected one, would point to repeated trauma.

---

* This fact has again been confirmed by Mr. Wainwright at the Liverpool Royal Infirmary, who followed up twenty-five cases of dislocation of the carpal semilunar bone several years after manipulative or operative reduction. In no case were the changes of Kienböck's disease found.

V. THE CLINICAL SIGNIFICANCE OF PATHOLOGICAL CALCIFICATION.

Supraspinatus Calcification.—It is now well known that the calcareous masses seen on the outer aspect of the shoulder-joint, which originally were thought to lie in the subdeltoid bursa,[111-116] have actually developed within the tendon of the supraspinatus. The amorphous calcium carbonate and phosphate forms a semi-liquid mass between the fibres of the tendon with no capsule or limiting membrane. There is neither clinical nor microscopic evidence of infection, and the pathological features of this condition differ in no respect from those of calcification elsewhere. It is not remarkable that of all the tendons in the body it is the supraspinatus which most commonly undergoes this change, for it is the only tendon in which there is normally constant compression against bone. Immediately above its insertion into the great tuberosity it occupies a vulnerable position, and impinges against the acromion with every abduction movement of the limb.

FIG. 328.—Calcification of the supraspinatus tendon.

FIG. 329.—Calcification of the supraspinatus tendon. Before operation. Same case as *Fig.* 338 (ossification of the tendo Achillis). (*Dr. Ransome's case.*)

The effect of this bony compression is seen in the fairly common syndrome of chronic supraspinatus tendonitis. There is tenderness immediately above the great tuberosity, and the arc of movement

between 60° and 120° of abduction is painful. The radiograph may show no abnormality and the symptoms subside with rest. Occasionally, however, a case is seen in which the symptoms are much more acute, and a localized swelling of the tendon may be felt as a nodule beneath the deltoid. The radiograph now shows that the fibrosis of constant trauma has resulted in calcification (*Fig.* 328). There is no room for expansion of the tendon between the tuberosity and the acromion, so that the two positions of comfort are with the arm by the side, or in hyper-abduction so that the tendon lies wholly beneath the acromio-clavicular joint and not in contact with the outer margin of the acromion. In a severe case the support of a sling is intolerable, and the arm must hang by the side with the elbow extended in order that the weight of the limb may increase as far as possible the space between the humerus and the acromion (*Fig.* 329).

Since the pain is of purely mechanical origin, the most rapid relief is secured by incising and evacuating the mass. A short incision is all that is required, and it is unnecessary to do more than to relieve the tension. If the deposit is sufficiently fluid to be withdrawn through an aspirating needle, the relief is equally complete and permanent. In less advanced cases the symptoms subside spontaneously as the volume of the deposit is reduced by desiccation. Moreover, an irritative hyperæmia may supervene and lead to the re-absorption of small deposits.

FIG. 330.—Cavernous angioma of forearm with calcification of thrombosed blood. X-ray showing diagnostic appearances.

Calcification of the Hæmatoma and the Cavernous Angioma.—A subperiosteal hæmatoma of bone is in direct association with an extensive store of calcium which is mobilized by the hyperæmia of the injury. From the earliest stages ossification is observed round the periphery of the blood-clot, gradually spreading throughout it. On the other hand, if a hæmatoma develops in soft tissues distant from bone, the only available source of calcium is through the blood-stream. No change occurs until the hæmatoma is organized and fibrous tissue has developed. The avascular tissue may now undergo calcification.

The sequence of events may be observed in the blood-clot within a vein which by calcification gives rise to a phlebolith. Although less commonly recognized, it is exactly the same process which accounts for the calcareous nodules in cavernous angiomata of muscles (*Fig.* 330). The nodules are shown radiographically as concentric rings varying in size from 1 mm. to 1 cm. in diameter. The calcareous deposit is not within the walls of the blood-vessels, but occurs only in the fibrous masses of organizing blood-clot. This was suggested by Ruggles,[117] who first drew attention to the condition in 1916,

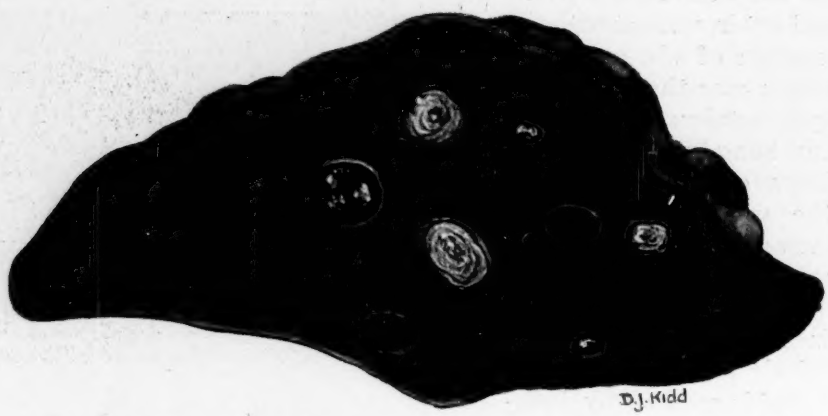


FIG. 331.—Cavernous angioma with calcification. Same case as *Fig.* 330.

and has been confirmed by examination of two recent cases (*Fig.* 331). As more blood-clot becomes organized, further concentric rings are added to the original nodule. If the shadows are seen in the regions where phleboliths do not occur, the appearances are diagnostic of the cavernous angioma.

Calcification in Raynaud's Disease.—Calcification in the skin and subcutaneous tissues of the fingers of patients suffering from Raynaud's disease was first described in 1911 by Thibierge and Weissenbach.[126] The concretions show a similar chemical constitution to pathological calcareous deposits elsewhere, and there is no alteration in the serum calcium concentration. Moreover, the calcification usually occurs after the phase of vasoconstriction with 'local asphyxia', and microscopic examination of the tissues shows fibrosis. The calcification occurs most constantly in the terminal phalanges, where there is normally a preponderance of fibrous tissue and where the impairment of vascularity will be most marked (*Fig.* 332). But deposits may also be seen in the subcutaneous tissues of the forearm (*Fig.* 333), and the radiographic features are very similar to those of the calcified cavernous angioma. Moreover, Weissenbach has described, and we have confirmed, the occurrence of multiple telangiectases in the skin and mucous membranes of cases of Raynaud's disease exhibiting calcinosis. It would appear, therefore, that in Raynaud's disease we have yet another example of calcification in fibrous tissue of impaired vascularity, and that the fibrosis may be increased by the organization of thrombi in small angiomata.

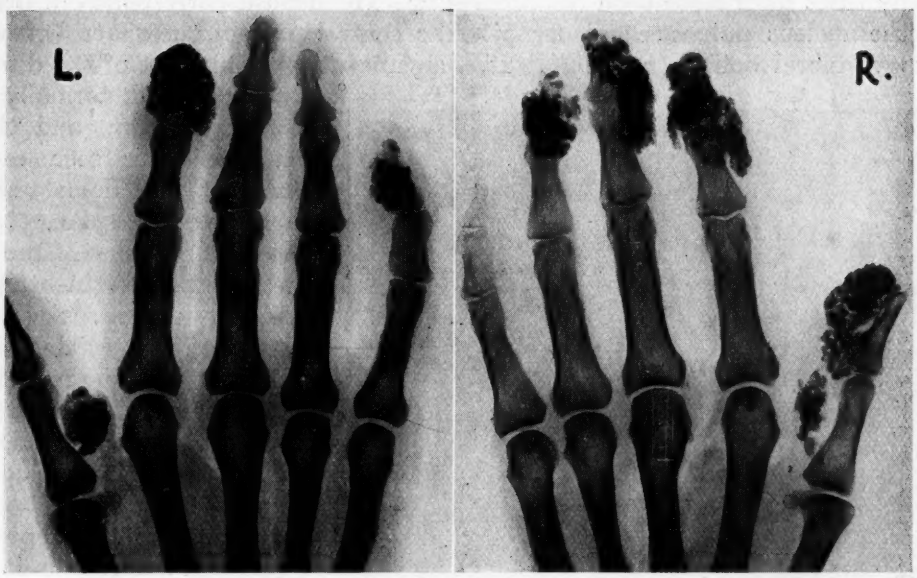


FIG. 332.—Calcification in Raynaud's disease.

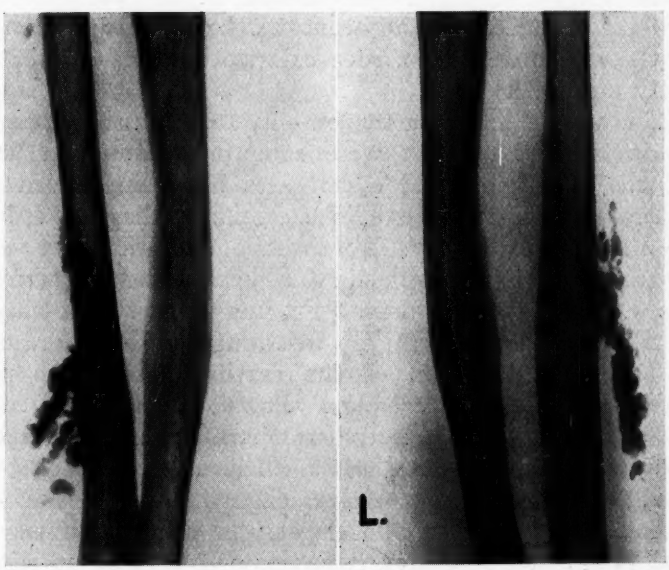


FIG. 333.—Calcification of forearm in Raynaud's disease.
Same case as *Fig.* 332.

Calcification of Intervertebral Discs.—Calcification in the nucleus pulposus of the intervertebral disc was first described by Calvé and Galland,[132] and many cases have since been recorded.[133-146] The deposit corresponds in shape to the nucleus pulposus and occupies the central part of the space between two vertebral bodies (*Fig.* 334). It is significant that this part of the disc is avascular and normally of low metabolism, and that calcification is seen most often at the dorsolumbar junction of the spine, where the minor strains of movement and of weight-bearing are concentrated. As with pathological calcification elsewhere, so soon as the deposit is sufficiently extensive to account for increased tension, pain is produced. Since the nucleus is avascular, these central deposits remain an amorphous mass of calcium and do not undergo conversion to bone unless vascularization takes place through destruction of the protective cartilaginous discs. On the other hand, Israelski[140] has described calcification in the peripheral part of an intervertebral disc immediately adjacent to the anterior common ligament. This part of the disc is capable of revascularization, and ossification is therefore frequently observed.

FIG. 334.—Calcification of intervertebral disc. There is calcification of the nucleus pulposus of one disc, and peripheral calcification of several discs.

Calcification of Semilunar Cartilages.—In 1927 Mandl[148] pointed out that microscopic deposits of calcium were sometimes found in the semilunar cartilages of the knee-joint, and eight cases have since been published in German literature of calcification of the cartilages diagnosed during life by radiographic examination.[148-155] The average age was over 45, but there has been no osteo-arthritic change in the joints, and not infrequently the disorder was entirely symptomless. Frequently both cartilages were involved and the calcium was diffusely distributed. In one case microscopic examination showed "depletion of the cartilage cells with predominance of fibrous tissue". One patient also showed pathological calcification of the popliteal artery and of the peripheral part of an intervertebral disc.[152] There can be no doubt, therefore, that calcification of the semilunar cartilages is evidence of a degenerative change in a relatively avascular fibrocartilaginous tissue. Since the deposit is usually diffuse so that the tension is not raised, the condition is not as a rule of great clinical significance, but it has an important bearing on ossification of the semilunar cartilage shortly to be described.

VI. THE CLINICAL SIGNIFICANCE OF PATHOLOGICAL OSSIFICATION.

In the clinical applications of pathological ossification two general types of bone formation must be distinguished: (1) Subperiosteal ossification; and (2) Heterotopic ossification. The first group includes not only the ossifying subperiosteal hæmatoma of the shaft of a long bone, but all forms of traumatic 'myositis ossificans'. The second group includes the localized formation of bone in scars and tendons, and the generalized form of fibrositis ossificans progressiva.

Subperiosteal Ossification and 'Myositis Ossificans'.—The periosteum is a fibrous membrane so closely applied to bone that when it is elevated it frequently carries with it bone cells. The membrane itself, however, is to be regarded as the limiting membrane of bone, and if the periosteum is raised, new bone is formed within the new limits of the periosteum. The periosteal elevation may be gradual and progressive from the traction of an active muscle. The 'rider's bone' and the spurs of the olecranon and of the os calcis are classical examples. The gluteal ridge, the linea aspera, and other normal bone ridges arise in the same way, and Greig[10] has shown how œdema of the periosteum will accentuate these muscle markings by facilitating periosteal elevation. Herein lies the explanation of the roughening of the fibula which occurs after osteomyelitis of the tibia, and the roughening of the shaft of any bone which has been fractured, especially when abnormal muscle strains are produced by malunion. On the other hand, the periosteum may be suddenly elevated by the hæmorrhage of scurvy or of injury. A hæmatoma limited by the displaced periosteum is in direct association with a tremendous store of calcium which is mobilized by the hyperæmia of the trauma, and ossification rapidly spreads throughout the mass of blood-clot. In the adult the condition is most commonly seen in the shaft of the femur after a direct kick (*Fig.* 335). The size of the traumatic osteoma is reduced

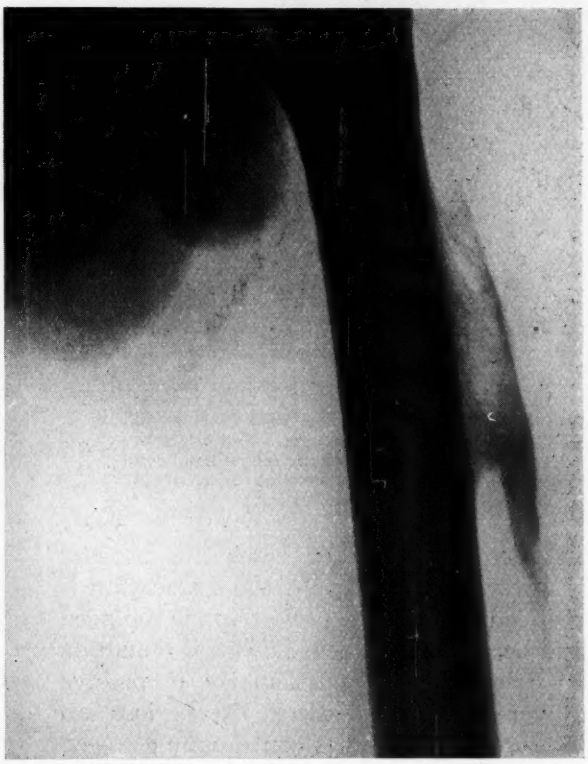


FIG. 335.—Ossification of traumatic subperiosteal hæmatoma of the shaft of the femur.

by spontaneous absorption of the hæmatoma, and may be minimized by aspiration in the early stages.

Several years ago one of the authors[156, 157] showed that the condition known as 'myositis ossificans' or 'tendonitis ossificans' was an exactly similar type of pathological ossification. The periosteum is elevated by the avulsion from bone of a muscle attachment, and ossification occurs within the subperiosteal hæmatoma. It is most common in children because the periosteum is less firmly attached to bone in the child than in the adult. It is most common at the elbow because this is the joint most commonly dislocated, and it is a joint which cannot be dislocated without the avulsion of muscles.

FIG. 336.—Avulsion of the brachialis anticus and common flexor muscles, with ossification of the subperiosteal hæmatoma. The avulsion produced by dislocation of the elbow has been perpetuated by passive extension movements of the joint. (*Dr. J. H. Mather.*)

FIG. 337.—Avulsion of the quadriceps with ossification of the subperiosteal hæmatoma. The knee-joint has not been immobilized, so that the new bone has remained fragmented and separated from the patella.

In adequately treated cases the disorder is never seen, because if the dislocation is reduced at once, the periosteum is replaced and becomes re-attached. But if reduction is delayed, and particularly if passive movements are practised, the periosteum is re-displaced, and is continually dragged farther away from the bone. The movement which is most commonly forced in injudicious treatment is extension, and, as would be expected, the periosteal displacement and new bone formation is seen at the attachment of the brachialis anticus to the ulna, and of the common flexors of the forearm to the humerus. A spur of bone may develop at both sites in the same case, and the subperiosteal hæmatomata may communicate with each other and produce a continuous bridge of bone (*Fig.* 336).

Similarly at the knee-joint, the quadriceps may be avulsed from the patella. If the muscle is stitched back, no new bone formation is seen. If it is not operated upon, the tonic contraction of the quadriceps maintains the periosteal displacement and bone develops in the subperiosteal hæmatoma above the patella. The new bone fuses with the patella if the joint is immobilized in extension, but it remains fragmented and is more diffuse if movements are carried out (*Fig.* 337).

Similarly, the ligamentum patellæ may be avulsed from the lower pole of the patella, and new bone is laid down unless the ligament is re-attached by operation.

The same sequence of events may occur at the hip-joint or at the shoulder-joint after traumatic dislocation where reduction is delayed or early passive movement practised, the periosteum in these cases being avulsed by the capsular ligaments. Bone spurs developing immediately in front of the ankle-joint are of exactly similar type and are due to avulsion of the anterior capsule. The term 'myositis ossificans' should not be applied to these cases. There is no myositis. The bone is not formed in muscle or in tendon. It is the subperiosteal ossification of avulsed muscles.

Fibrositis Ossificans Progressiva.—The use of the term 'myositis ossificans' should be confined to cases of the progressive disease, which differs etiologically, pathologically, and clinically from the traumatic condition we have discussed. Greig[10] has suggested the more accurate nomenclature "fibrositis ossificans progressiva", for even in this condition new bone is formed, not in muscles, but in the fibrous-tissue planes of tendons and muscles. The fibrous tissue undergoes de-differentiation to the embryonic state and is built up again as bone. The factors determining this de-differentiation are unknown, but there is definite evidence that the disorder is of congenital origin.

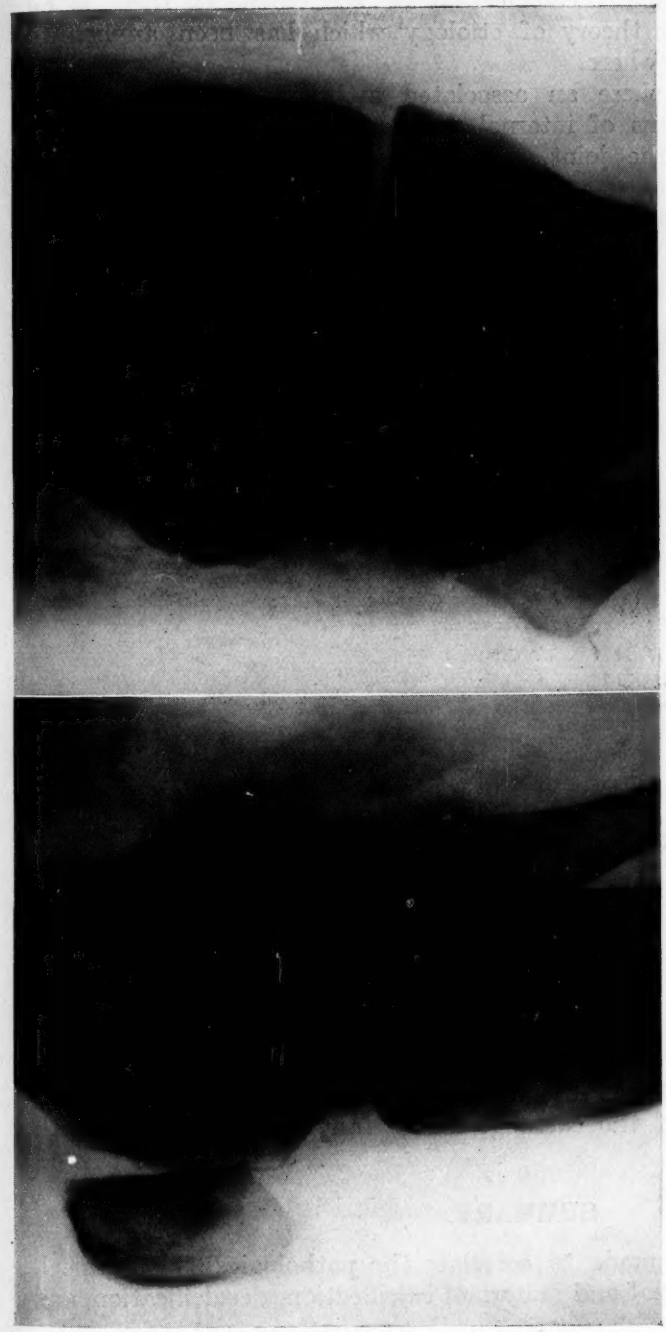
Ossification of the Tendo Achillis.—True heterotopic ossification may result from the revascularization of pathological calcareous deposits. In the tendo Achillis it would be possible for pathological calcification to occur without giving rise to symptoms, because the mechanical factors which account for pain in calcification of the supraspinatus tendon are absent. This may explain the fact that although eight cases of ossification of the tendo Achillis have been described,[158–164] the earlier stage of amorphous calcification has not been observed. In many of the recorded cases of heterotopic ossification of the tendo Achillis, and in the two further cases now recorded (*Fig.* 338), the diagnosis has been established twenty years or more after subcutaneous tenotomy. It may be accepted, therefore, that there has been fibrosis of a tendon of low vascularity which could produce a calcareous deposit, and that after a long interval of time the the irritative effect of the deposit has led to revascularization with the development of bone.

An attempt was made by Macdonald at the Shropshire Orthopædic Hospital, and Sayle Creer at the Liverpool Royal Infirmary, to estimate the frequency of ossification as a complication of tenotomy of the tendo Achillis, but although fifty patients who had undergone tenotomy were X-rayed, none showed calcification or ossification. It was found impossible to trace the older patients, and the average interval of time which had elapsed since tenotomy was less than ten years.

As a general rule the ossification has not been associated with serious symptoms, but in Mallinson's case[163] the resulting diminution in the elasticity of the tendon predisposed to spontaneous rupture necessitating operative suture.

FIG. 338.—Ossification of the tendo Achillis. Twenty years after subcutaneous tenotomy. Same case as *Fig.* 329 (calcification of supraspinatus tendon).

Ossification of the Semilunar Cartilages.—Although several cases of calcification of the semilunar cartilages have been reported (p. 488), we have been unable to find any reference in the literature to ossification of the cartilage, and we believe that two cases are here recorded for the first time (*Fig.* 339). In both cases the external cartilage was involved, the bone deposits varying in size from that of a pea to that of a large hazel-nut. Although in the first case one deposit was in the anterior cornu and extended into the fibrous attachment of the cartilage to the tibia, there was no continuity with normal bone; moreover, in the other case two discrete bony deposits, one in the anterior third and one in the posterior third,



A

B

FIG. 339.—Ossification of external semilunar cartilage. A, Radiograph of knee-joint; B, Radiograph of cartilage after excision.

were entirely surrounded by normal cartilage (*Fig.* 340). The condition is therefore a true example of heterotopic bone formation. In view of the recorded cases of pathological calcification of the cartilages there is no difficulty in applying the theory of etiology which has been applied to heterotopic ossification elsewhere.

In neither case was there an associated arthritic change, but both patients presented symptoms of internal derangement—weakness, recurring effusion, 'giving way' of the joint, and pain in the outer compartment. In the case in which there was a large deposit in the anterior third of the cartilage the terminal 15° of extension were limited by an elastic

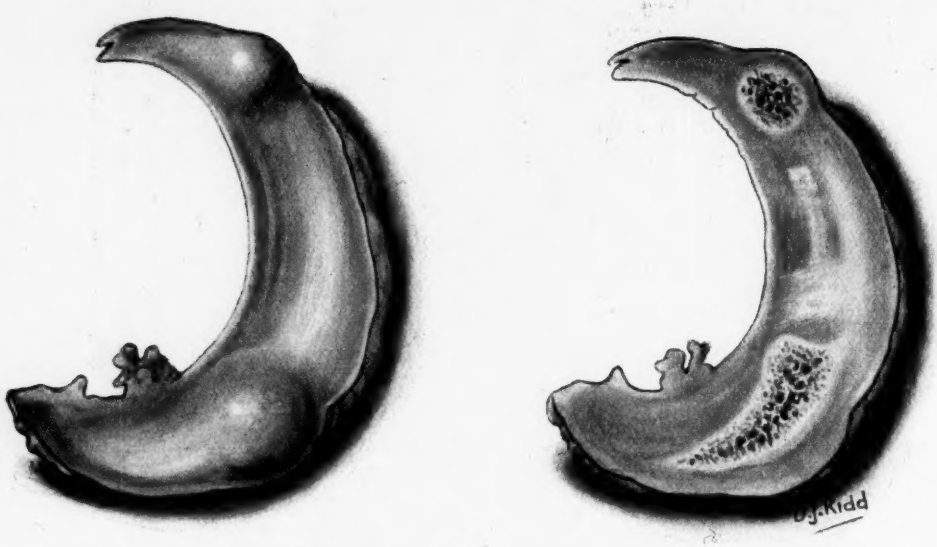


FIG. 340.—Ossification of external semilunar cartilage. Specimen removed from second case.

resistance suggestive of an unreduced bucket-handle cartilage tear. In both cases the pre-operative clinical and X-ray diagnosis was "loose bodies in the knee-joint". In the first it was obvious as soon as the joint was opened that there was a tumour of the cartilage, and the operation presented no difficulty. In the second case a prolonged search for the expected loose body was made before the possibility of ossification of the cartilage was recalled. Removal of the cartilage relieved the symptoms in both cases. Histological examination of the cartilage shows fully developed bone with Haversian systems.

SUMMARY.

An attempt has been made to correlate the pathological, biochemical, and clinical features of normal and abnormal calcification, decalcification, and ossification.

Pathological Considerations.—

1. Bone undergoes decalcification if the blood-supply is increased, and increased calcification if the blood-supply is decreased.

2. Pathological calcification is observed in any mesenchymatous tissue of low metabolism when the vascularity is further reduced by the fibrosis of trauma or of infection.

3. Bone may form in any region where there are fibroblasts, excess of calcium, and an adequate blood-supply.

Radiological Applications. —

1. The radiologist must interpret decalcification of bone as evidence of hyperæmia, and increased calcification as evidence of ischæmia. If in the presence of decalcification of adjacent bones one fragment retains its original calcium content, the fragment is avascular. This may prove dislocation which is now reduced (e.g., astragalus, semilunar, scaphoid).

2. Hyperæmic decalcification must be distinguished from destruction. Decalcified bone adjacent to an infective focus may appear to be destroyed though actually normal. In tuberculous disease the area of destruction is much less than the area of decalcification. In osteolytic sarcomata the tumour is less extensive than X-rays suggest. Apparent regeneration after treatment is due to recalcification.

Hyperæmic Decalcification of Bone.—

1. Non-union of fractures is due to traumatic hyperæmic decalcification from inadequate immobilization. Compound fractures, although more decalcified owing to infective hyperæmia, may still unite if immobilized.

2. A bone-graft never becomes vascularized. It is a local excess of calcium which assists in the repair of ununited fractures, tuberculous osteitis, and bone cysts.

3. Three degrees of spontaneous hyperæmic dislocation of the atlas may occur: (*a*) without complication, (*b*) with paraplegia, (*c*) with sudden death.

4. Nephrolithiasis may result from generalized disuse and recumbency in fractures, tuberculous joints, pneumonia, etc., owing to excessive excretion of calcium. It is similar to the renal calculi of osteitis fibrosa and the vesical calculi of osteitis deformans.

Ischæmic Sclerosis of Bone.—

1. Increased calcification of bone is evidence of diminished vitality. The elasticity is reduced and the bone is abnormally fragile (Paget's disease, Albers-Schönberg's disease, Charcot's disease).

2. Kienböck's disease of the semilunar is due to impaired vascularity. The bone undergoes necrosis and must be excised. Preiser's disease of the scaphoid is not a clinical entity. It is a stage of non-union of fracture of the scaphoid and is cured by immobilization.

3. Panner's and Freiberg's disease of the metatarsal are due to impaired vascularity and are analogous to Kienböck's disease.

Pathological Calcification.—

1. Calcification of the supraspinatus tendon is due to the trauma of impingement of the tendon against bone. Pain is due to tension, and symptoms are relieved by any measure which reduces tension. Spontaneous absorption may occur.

2. The hæmatoma undergoes calcification when it is organized. The phlebolith, the calcified cavernous angioma, and the calcinosis of Raynaud's disease are of a similar type.

3. Calcification of the intervertebral disc and the semilunar cartilage are due to impairment of vascularity from repeated slight traumata.

Pathological Ossification.—

1. Whenever the periosteum is elevated, bone is found within the new limits of the periosteum (bone spurs, normal bone ridges, subperiosteal hæmatomata).

2. The subperiosteal ossification of avulsed muscles may occur at the elbow, knee, ankle, or shoulder. It is purely traumatic and can be prevented. The term 'myositis ossificans' should not be applied to these cases but should be reserved for the progressive disease.

3. Heterotopic ossification of tendon is most common in the tendo Achillis; in such cases tenotomy is frequently a causative factor.

4. Ossification may occur in the semilunar cartilages. The condition is difficult to differentiate radiologically from loose bodies in the knee-joint.

REFERENCES.

Theories of Pathological Calcification.—

[1] GRANDIS and MAININI, *Arch. ital. de Biol.*, 1900, i, 73.
[2] PFAUNDLER, *Jahrb. f. Kinderheilk.*, 1904, lx, 123.
[3] PAULI and SAMEC, *Biochem. Zeits.*, 1909, xvii, 235.
[4] HOFMEISTER, *Ergebn. d. Physiol.*, 1910, x, 429.
[5] WELLS, *Arch. of Internal Med.*, 1911, vii, 721.
[6] FREUDENBERG and GYORGY, *Biochem. Zeits.*, 1920, cx, 299.
[7] WATT, *Arch. of Surg.*, 1925, x, 983.
[8] LERICHE and POLICARD, *La Physiologie normale et pathologique de l'Os*, 1926. Paris.
[9] LERICHE and POLICARD, *Physiologie pathologique chirurgicale*, 1930. Paris.
[10] GREIG, *Surgical Pathology of Bone*, 1931. [redacted]burgh.

The Chemical Constitution of the Bone Salt.—

[11] GASSMANN, *Zeits. Physiol. Chem.*, 1910, lxx, 161.
[12] BASSETT, *Jour. of Chem. Soc.*, 1917, cxi. 620.
[13] DE JONG, *Rec. Trav. chim.*, 1926, xlv, 445.
[14] TAYLOR and SHEARD, *Jour. of Biol. Chem.*, 1929, lxxxi, 479.
[15] ROSEBERRY, HASTINGS, and MORSE, *Ibid.*, 1931, xc, 395.
[16] MORGULIS, *Ibid.*, 1931, xciii, 455.
[17] BOGERT and HASTINGS, *Ibid.*, 1931, xciv, 473.

The Phosphatase Activity of Tissues.—

[18] ROBISON, *Biochem. Jour.*, 1923, xvii, 286.
[19] ROBISON and SOAMES, *Ibid.*, 1924, xviii, 740.
[20] MARTLAND and ROBISON, *Ibid.*, 765, 1354.
[21] ROBISON, *The Significance of Phosphoric Esters in Metabolism*, 1932. New York.
[22] HUGGINS, *Biochem. Jour.*, 1931, xxv, 728.
[23] HUGGINS, *Arch. of Surg.*, 1931, xxii, 377.
[24] MARTLAND, *Biochem. Jour.*, 1925, xix, 117.

Metastatic Calcification in Hypercalcæmia.—

[25] HUEPER, *Arch. Pathol. and Lab. Med.*, 1927, iii, 14.
[26] DAWSON and STRUTHERS, *Edin. Med. Jour.*, 1923, xxx, 421.
[27] BULGER DIXON, and BARR, *Jour. Clin. Invest.*, 1930, ix, 143.
[28] QUICK and HUNSBERGER, *Jour. Amer. Med. Assoc.*, 1931, xcvi, 745.
[29] HUNTER, *Brit. Jour. Surg.*, 1931, xix, 203.
[30] HUNTER, *Lancet*, 1930, i, 897.

Calcification of Costal Cartilages.—

[31] CHAUMET and ZAWADOWSKI, *Rev. de Tubercul.*, [redacted]27, viii, 574.
[32] RIST, GALLY, and TROCMÉ, *Presse méd.*, 1928, [redacted]xvi, 641.

[33] Riebel, *Amer. Jour. Roentgenol.*, 1929, xxi, 44.
[34] Helly, *Zeits f. d. ges. Anat.*, 1929, lxxxviii, 746.
[35] Ernst, *Forts. a. d. Geb. d. Röntgenstrahlen*, 1929, xxxix, 485.

Calcification of Pineal Body.—

[36] Bronner, *Forts. a. d. Geb. d. Röntgenstrahlen*, 1926, xxxv, 277.
[37] Cignolini, *Rev. franç. d'Endocrinol.*, 1927, v, 324.
[38] Faelli, *Endokrinologie*, 1930, vii, 189.
[39] Toussaint, *Arch. méd. belges*, 1930, lxxxiii, 462.
[40] Elkington, *Proc. Roy. Soc. Med.*, 1932, xxv, 1533.

Calcification of the Pericardium.—

[41] Cutler and Sosman, *Amer. Jour. Roentgenol.*, 1924, xii, 312.
[42] Amundsen, *Acta. Radiol.*, 1923, ii, 38.
[43] Case, *Jour. Amer Med. Assoc.*, 1923, lxxx, 236.
[44] Scholz, *Arch. of Internal Med.*, 1924, xxxiv, 32.
[45] Jones and Roberts, *Brit. Jour. Radiol.*, 1927, xxxii, 167.

Calcification in Uterine Fibroids and Fibromata.—

[46] Mather, *Brit. Jour. Radiol.*, 1927, xxxii, 257.
[47] Arens and Bloom, *Radiology*, 1928, x, 256.
[48] Alix, *Jour. de Radiol. et d'Électrol.*, 1928, xii, 287.
[49] Archer and Greenberg, *Amer. Jour. Obst. and Gynecol.*, 1931, xxi, 335.

Immobilization and Union in Fracture of Neck of Femur and Scaphoid.—

[50] Smith Petersen, *Arch. of Surg.*, 1931, xxiii, 715.
[51] Böhler, *Treatment of Fractures*, 1929. Vienna.
[52] Watson Jones, *Brit. Med. Jour.*, 1932, i, 1073.

Treatment of Infected Fractures.—

[53] Winnett Orr, *Osteomyelitis and Compound Fractures*, 1929. London.
[54] Watson Jones, *Jour. Bone and Joint Surg.*, 1932, xiv, 609.

Osteogenesis in Vitro.—

[55] Fell, *Arch. f. exper. Zellforsch.*, 1928, vii, 70.
[56] Fell and Robison, *Biochem. Jour.*, 1929, xxiii, 767.
[57] Fell and Robison, *Ibid.*, 1930, xxiv, 1905.
[58] Fell, *Arch. f. exper. Zellforsch.*, 1931, xi, 245.
[59] Fell, *Jour. of Anat.*, 1932, lxvi, 2, 157.

Robertson-Lavalle Operation for Tuberculous Joints.—

[60] Robertson-Lavalle, *Ann. de la Faculté de Méd. de Montevideo*, 1919.
[61] Robertson-Lavalle, *Bull. et Mém. Soc. de Chir.*, 1923, xliv, 812.
[62] Robertson-Lavalle, *Rev. d'Orthop.*, 1924, xi, 5.
[63] Robertson-Lavalle, *Arch. latino-amer. de Pédiat.*, 1925, Nov.
[64] Ruiz-Moreno, *Semana Méd.*, 1927, ii, 106.
[65] Mouchet, *Congrès Chir.*, 1925, xxxiv, 276. Paris.
[66] Ombrédanne, *Bull. et Mém. Soc. de Chir.*, 1926, lii, 955.
[67] Sorrel, *Ibid.*, 1925, Dec.
[68] Tavernier, *Lyon chir.*, 1930, xxvii, 645.
[69] Uffreduzzi and Biancalana, *Presse méd.*, 1931, xxxix, 242.
[70] Vignard, *Lyon. chir.*, 1927, xxiv, 576.

Kümmell's Disease of the Spine.—

[71] Kümmel, *Deut. med. Woch.*, 1895, xxi, 280.
[72] Calvé, *Jour. de Radiol. et d'Electrol.*, 1925, ix, 22.
[73] Watson Jones, *Jour. Bone and Joint Surg.*, 1930, xiii, 383.
[74] Watson Jones, *Brit. Med. Jour.*, 1931, i, 31.

Spontaneous Hyperæmic Dislocation of the Atlas.—

[75] Gillette, *N.Y. Med. Jour.*, 1896, lxiv, 158.
[76] Swanberg, *Jour. Amer. Med. Assoc.*, 1919, lxxii, 107.
[77] Grisel, *Presse méd.*, 1930, xxxviii, 50.
[78] Desfosses, *Ibid.*, 1930, xxxviii, 1179.
[79] Berkheiser and Seidler, *Jour. Amer. Med. Assoc.*, 1931, xcvi, 517.
[80] Bell, *Nervous System of the Human Body*, 1830, App. 127, 64.
[81] Greig, *Surgical Pathology of Bone*, 1931, 228. Edinburgh.
[82] Watson Jones, *Proc. Roy. Soc. Med.*, 1932, xxv, 586.

Renal Calculi as a Late Complication of Fractures and Gunshot Wounds.—

[83] PAUL, *Canad. Med. Assoc. Jour.*, 1922, xli, 638.
[84] ROSENSTEIN, *Zeits. f. Urol. Chir.*, 1926–7, xxi, 326.
[85] ROSENSTEIN, *Med. Welt*, 1930, iv, 395.
[86] BLOCK, *Zeits. f. Urol.*, 1931, xxv, 332.
[87] MARSHALL, *U.S. Nav. Med. Bull.*, 1931, xxix, 472.
[88] BOSHAMER, *Arch. f. Orthop. u. Unfall-Chir.*, 1932, xxxii, 84.
[89] VOLKMANN, *Arch. f. klin. Chir.*, 1932, clxxi, 86.

Spontaneous Fractures in Paget's Disease.—

[90] ROBERTS and COHEN, *Proc. Roy. Soc. Med.*, 1926, xix, 14.

Albers-Schönberg's Disease.—

[91] ALEXANDER, *Amer. Jour. Roentgenol*, 1923, x, 280. (Review of literature to 1921.)
[92] DAVIS, *Arch. of Surg.*, 1922, v, 449.
[93] CLAIRMONT and SCHINZ, *Arch. f. klin. Chir.*, 1924, cxxxii, 347.
[94] KRAUS and WALTER, *Med. Klin. Berl.*, 1925, xxi, 19.
[95] LAUTERBURG, *Schweiz. med. Woch.*, 1926, vii, 441.
[96] COHN, MAX, and SALINGER, *Med. Klin.*, 1927, xxiii, 825.
[97] BERNHARDT, *Klin. Woch*, 1926, v, 415.
[98] BUSCHKE and OLLENDORFF, *Dermatol. Woch.*, 1928, lxxxvi, 257.
[99] D'ISTRIA, *Radiol. med.*, 1928, xv, 473.
[100] MERRILL, *Amer. Jour. Roentgenol.*, 1929, xxi, 361.
[101] SEAR, *Brit. Jour. Surg.*, 1927, xiv, 657.
[102] PIRIE, *Amer. Jour. Roentgenol*, 1930, xxiv, 147.

Kienböck's, Preiser's, Panner's Diseases, etc.—

[103] PREISER, *Forts. a. d. Geb. d. Röntgenstrahlen*, 1910, xv, 189; xvi, 360.
[104] HAENISCH, *Ibid.*, xvi, 239.
[105] KIENBÖCK, *Ibid.*, 77.
[106] HIRSCH, *Ibid.*, 223.
[107] BUCKMAN, *Ann. of Surg.*, 1928, lxxxvii, 892.
[108] KÖHLER, *Münch. med. Woch.*, 1908, xlv, 1923.
[109] PANNER, *Acta Radiol.*, 1922.
[110] FREIBERG, *Jour. Bone and Joint Surg.*, 1926, viii, 257.

Calcification of Supraspinatus Tendon.—

[111] PAINTER, *Boston Med. and Surg. Jour.*, 1907, clvi, 345.
[112] CODMAN, *Ibid.*, 1908, clix, 533, and 1911, clxv, 115.
[113] BRICKNER, *Amer. Jour. Med. Sci.*, 1915, cxlix, 351.
[114] ELMSLIE, *Brit. Med. Jour.*, 1931, ii, 898.
[115] ELMSLIE, *Brit. Jour. Surg.*, 1932, xx, 190.
[116] WATSON JONES, *Brit. Med. Jour.*, 1931, ii, 898.

Calcification in the Hæmangiomata.—

[117] RUGGLES, *Amer. Atlas Stereoroentgenol.*, 1916, i, 82.
[118] RUGGLES, *Amer. Jour. Roentgenol.*, 1919, vi, 512.
[119] WAKELEY, *Arch. Radiol. and Electrol.*, 1921, xxv, 343.
[120] RAVOLD, *Jour. Radiol.*, 1924, iii, 231.
[121] DUNN, *Ann. of Surg.*, 1925, lxxxii, 880.
[122] JOHNSON, *Jour. Amer. Med. Assoc.*, 1928, xc, 1108.

Calcification in Meningeal Hæmangiomata.—

[123] KRABBE, *Rev. neurol.*, 1929, i, 1152.
[124] KRABBE and WISSING, *Acta radiol.*, 1929, x, 523.
[125] PÉHN, DECHAUME, and BOUCOMONT, *Lyon méd.*, 1932, cxlix, 249.

Calcification in Raynaud's Disease.—

[126] THIBIERGE and WEISSENBACH, *Ann. de Dermatol. et Syph.*, 1911, ii, 129.
[127] FERNET and NAHAN, *Bull. Soc. de Dermatol. et Syph.*, 1919, xxvi, 266.
[128] WEIL, WEISSMANN-NETTER, *Ann. de Dermatol. et Syph.*, 1924, v, 724.
[129] LEHRNBECHER, *Beitr. z. klin. Chir.*, 1928, cxlii, 380.
[130] WEISSENBACH, VIGNAL, and GUILLAUMIN, *Bull. Soc. de Dermatol. et Syph.*, 1929, xxxvi, 910.
[131] WEISSENBACH, TRUCHOT, FRANCON, and LAUDAT, *Bull. Soc. méd. Hôp. de Paris*, 1931, xlvii, 837.
[132] GARCIN, BERTRAND, LAUDAT, and CACHIN, *Ibid.*, 1931, xlvii, 1036.

Calcification of Intervertebral Discs.—

133 CALVÉ and GALLAND, *Jour. de Radiol. et d'Electrol.*, 1922, vi, 21.
134 BARON, *Zentralb. f. Chir.*, 1924, li, 250.
135 HORENSTEIN, *Forts. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 713 (with literature).
136 KRONENBERGER, *Röntgenpraxis*, 1929, i, 898.
137 DITTRICH, *Amer. Jour. Surg.*, 1929, vii, 840.
138 SCHMORL, *Forts. a. d. Geb. d. Röntgenstrahlen*, 1929, xl, 18.
139 BRETON, *Jour. de Radiol. et d'Electrol.*, 1929, xiii, 277.
140 ISRAELSKI and POLLACK, *Beitr. z. klin. Chir.*, 1930, cl, 476.
141 LYON, *Arch. f. Orthop.*, 1930, xxviii, 717.
142 BARSONY and KOPPENSTEIN, *Forts. a. d. Geb. d. Röntgenstrahlen*, 1930, xli, 211.
143 ROVEKAMP, *Röntgenpraxis*, 1930, ii, 186.
144 MANTOVANI, *Arch. franco-belges de Chir.*, 1930, xxxii, 488.
145 ROEDERER, *Bull. et Mém. Soc. des Chir.*, 1931, xxiii, 596.
146 CALVÉ and GALLAND, *Rev. d'Orthop.*, 1931, xviii, 782.
147 RATHCKE, *Forts. a. d. Geb. d. Röntgenstrahlen*, 1932, xlvi, 66.

Calcification of Semilunar Cartilages.—

148 MANDL, *Arch. f. klin. Chir.*, 1927, cxlvi, 149.
149 WERWATH, *Forts. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxvii, 169.
150 BRUCHOLY, *Röntgenpraxis*, 1929, i, 888.
151 SCHWARTZ, *Ibid.*, 1930, ii, 380.
152 ISRAELSKI and POLLACK, *Beitr. z. klin. Chir.*, 1930, cl, 476.
153 ISRAELSKI, *Amer. Jour. Roentgenol.*, 1931, xxv, 85.
154 HENRICHSEN, *Röntgenpraxis*, 1932, lv, 403.
155 MERCER, *Orthopædic Surgery*, 1932, 426. London.

Subperiosteal Ossification.—

156 WATSON JONES, *Brit. Med. Jour.*, 1930, ii, 592.
157 WATSON JONES, *Canad. Med. Assoc. Jour.*, 1931, xxiv, 803.

Ossification of the Tendo Achillis.—

158 SAINTON and PERON, *Paris méd.*, 1922, xii, 342.
159 STEIGER, *Wien. klin. Woch.*, 1925, xxxviii, 1012.
160 HAGLUND, *Zeits. f. orthop. Chir.*, 1927, xlix, 49.
161 PATEL, *Lyon chir.*, 1931, xxviii, 351.
162 BRUMAGH, *Jour. Bone and Joint Surg.*, 1932, xiv, 953 (with bibliography).
163 MALLINSON, *Brit. Med. Jour.*, 1932, ii, 836.
164 WATSON JONES, *Ibid.*, 943.

A CASE OF HYPERPARATHYROIDISM WITH CERTAIN UNUSUAL FEATURES.

By T. W. MIMPRISS,
SURGICAL REGISTRAR, ST. THOMAS'S HOSPITAL,

AND R. W. BUTLER,
LATE CHIEF ASSISTANT, ORTHOPÆDIC DEPARTMENT, ST. THOMAS'S HOSPITAL.

THE syndrome of hyperparathyroidism with a parathyroid tumour and changes in the bones has received so much attention in recent years that the main object in reporting the following case is to describe its occurrence in an adolescent patient, in whom growth is still taking place rapidly, and in whom therefore the bone changes are somewhat atypical.

CASE REPORT.

A stable boy, aged 17, was admitted to St. Thomas's Hospital on May 31, 1932, with a history of three months' pain in the knees, causing increasing difficulty in walking. Pressure over the long bones caused pain.

His appearance and mentality were those of a child of 14 and he had grown very little during the last three years.

Late rickets was suggested by a bossed forehead, enlargement of the costo-chrondral junctions and of the radial, femoral, and tibial epiphyses, and muscular hypotonia was marked. Radiograms of the knees and wrists showed transverse bands of dense bone at the metaphyses, separated from the epiphysial lines by a narrow area of irregular ossification (*Fig.* 341). The bones generally showed some decalcification. In the shafts of the femora and one tibia were localized areas of rarefaction, suggesting early cyst formation.

The possibility of early renal rickets was not supported by an examination of the renal function.

Urine.—Specific gravity, 1022. No abnormal constituents found. Blood-urea : 34 mgrm. per 100 c.c.

Urea-concentration Test.—Fifteen grm. of urea were given. Percentage of urea in urine was : 1st hour, 2·1 ; 2nd hour, 2·2 ; 3rd hour, 2·4.

The blood-vessels were normal.

He had a small, dark-red tumour arising from the gum in front of the lower first bicuspid tooth on the right side. The teeth were normally erupted and an X-ray plate showed no change in the mandible. The serum calcium was raised to 14·6 mgrm. per 100 c.c., while the plasma phosphorus was 4·7 mgrm. per 100 c.c. His weight at this time (May 21) was 5 st. 12 lb. 10 oz.

He was kept under observation until July 31, with a tentative diagnosis of early hyperparathyroidism, his condition remaining unchanged.

At this time his serum calcium had risen to 18 mgrm. per 100 c.c. and his plasma phosphorus had fallen to 2·9 mgrm. per 100 c.c., while at the same time his renal function had deteriorated considerably. His urine contained a trace of albumin and numerous hyaline and epithelial casts. The

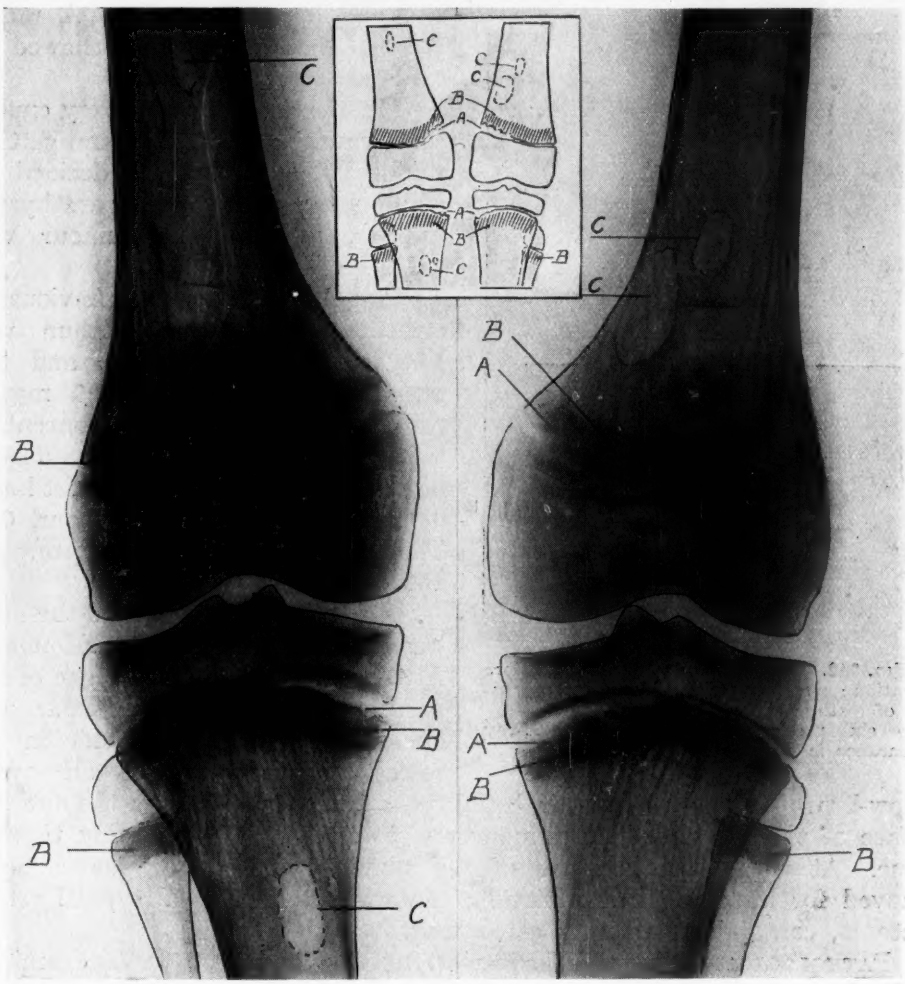


FIG. 341.—X-ray of knees before operation, taken in July, 1932. Showing: *A*, Irregular widening of epiphysial lines; *B*, Transverse bands of increased density at the metaphyses; *C*, Localized areas of decreased density suggesting early cyst formation.

blood-urea was 62 mgrm. per 100 c.c. A urea-concentration test was as follows (15 mgrm. of urea given)—percentage of urea in urine: 1st hour, 1·9; 2nd hour, 1·9; 3rd hour, 1·4.

Frequent vomiting now became a notable feature, and by the end of July the patient weighed only 4 st. 12 lb., a stone less than when he was first seen at the end of May. The tumour of the jaw had increased

in size and a similar tumour appeared near the first lower molar on the left side.

Radiographic examination of the bones now showed that the irregular ossification at the metaphyses remained unaltered. The cystic areas were still present in the tibiæ and femora, and others had appeared in the right radius and also in the mandible underlying the tumours visible in the mouth (*Fig.* 342 A). The cystic areas in the long bones were more definite than in the previous radiograms. A radiogram of the lumbar region showed no evidence of renal calculi.

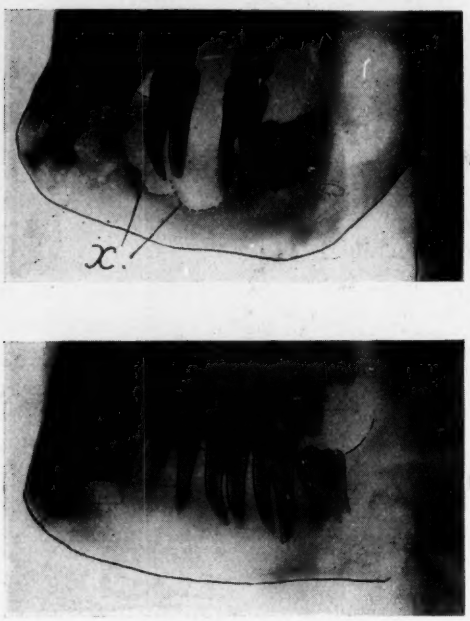


FIG. 342.—A, Mandible in July, 1932, before operation : *x* shows erosion of bone and separation of teeth at site of osteoclastoma. B, Mandible six months after operation. X-ray appearance is now normal.

The patient was now very emaciated, vomiting frequently, and getting rapidly weaker. It was decided to explore the neck for a parathyroid tumour, although no tumour was palpable.

On Aug. 4, the day previous to operation, the serum calcium was 18·8 mgrm. per 100 c.c. and the plasma phosphorus was 2·9 mgrm. per 100 c.c., while a urea-concentration test gave the following reading—percentage of urea in urine : 1st hour, 0·8 ; 2nd hour, 0·9 ; 3rd hour, 0·8. The blood-urea was 66 mgrm. per 100 c.c.

OPERATION.—On Aug. 5 the neck was explored by Mr. W. H. C. Romanis. At the usual sites of occurrence of the parathyroid bodies no tumour was evident. A search was made in the retrosternal region and an ovoid yellow-brown tumour, 12 mm. in length, was found embedded in the anterior surface of the thymus. The tumour was excised with surrounding thymus tissue. At the same time one of the tumours of the jaw was partially removed for histological examination, and was found to be a typical osteoclastoma, containing numerous osteoclasts.

PATHOLOGICAL REPORT.—The retrosternal tumour (*Fig.* 343) was examined by Professor L. S. Dudgeon, who reported upon it as follows :—

The tumour is encapsulated ; small blood-vessels are visible throughout, but the tissue is not very vascular. The tumour is composed almost entirely of one type of cell—the principal cell of the parathyroid gland. The nuclei are vesiculated to a varying degree, and contain nucleoli and a well-marked chromatin network. The cytoplasm is basophilic and shows granular marking. The cell membrane is distinct. The cells are densely packed throughout the tissue and are either polyhedral or arranged in columns about the blood-vessels. There are also a few small islets of cells surrounded by a thin fibrous capsule. These consist of foam cells of various sizes containing one or more

nuclei. The nuclei are relatively small and pale. The cytoplasm is pale and finely granular. No oxyphil cells were seen in the sections.

Subsequent Progress.—The patient stood the operation well, and a striking improvement in his general condition followed rapidly. The frequent vomiting which had occurred before operation immediately ceased. His appetite, which had been small and capricious, improved steadily, while

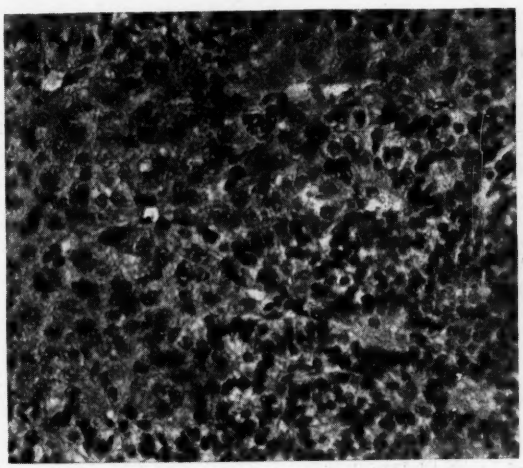


Fig. 343.—Microscopical appearance of tumour removed.

his weight, which was 4 st. 12 lb. 9 oz. on Aug. 4, the day before operation, was 5 st. 10 lb. 6 oz. on Aug. 18, and 6 st. on Aug. 22. The bone pains and bone tenderness were gone within a few days. The serum calcium and phosphorus readings underwent a sudden change following the operation.

Aug. 4.—The day before operation: Serum calcium 18·8 mgrm. per 100 c.c. Plasma phosphorus 2·9 mgrm. per 100 c.c. Blood-urea 66 mgrm. per 100 c.c.

Aug. 5.—Operation.

Aug. 6.—Serum calcium 12·7 mgrm. per 100 c.c. Plasma phosphorus 2·14 mgrm. per 100 c.c. Blood-urea 66 mgrm. per 100 c.c.

Aug. 8.—Serum calcium 8·8 mgrm. per 100 c.c. Plasma phosphorus 2·3 mgrm. per 100 c.c.

Aug. 12.—Serum calcium 10 mgrm. per 100 c.c. Plasma phosphorus 2·38 mgrm. per 100 c.c. Blood-urea 28 mgrm. per 100 c.c.

Aug. 18.—Serum calcium 10·9 mgrm. per 100 c.c. Plasma phosphorus 4·32 mgrm. per 100 c.c. These last readings are within normal limits.

Immediately after the operation the patient had been placed on a high calcium diet. It is interesting to note that there were no manifestations of tetany.

On Aug. 29 the patient was transferred to a convalescent home. He was then in good general health and putting on weight rapidly. The pain in his limbs had disappeared and he was able to walk.

On Oct. 10 the boy was seen again. He could walk easily and was in

good general health. His serum calcium was 10·8 mgrm. per 100 c.c. and his plasma phosphorus was 4·9 mgrm. per 100 c.c. The tumours of the jaw were slightly smaller. Radiograms of the bones showed no alteration from those taken before operation, the changes at the metaphyses and the cystic areas being still apparent. He was sent back to his home, with instructions to report again in the new year.

On March 6, 1933, the patient was again admitted to St. Thomas's Hospital for observation. He was then in good health, walking normally and anxious to resume work. His weight had increased to 7 st. 12 lb. Of

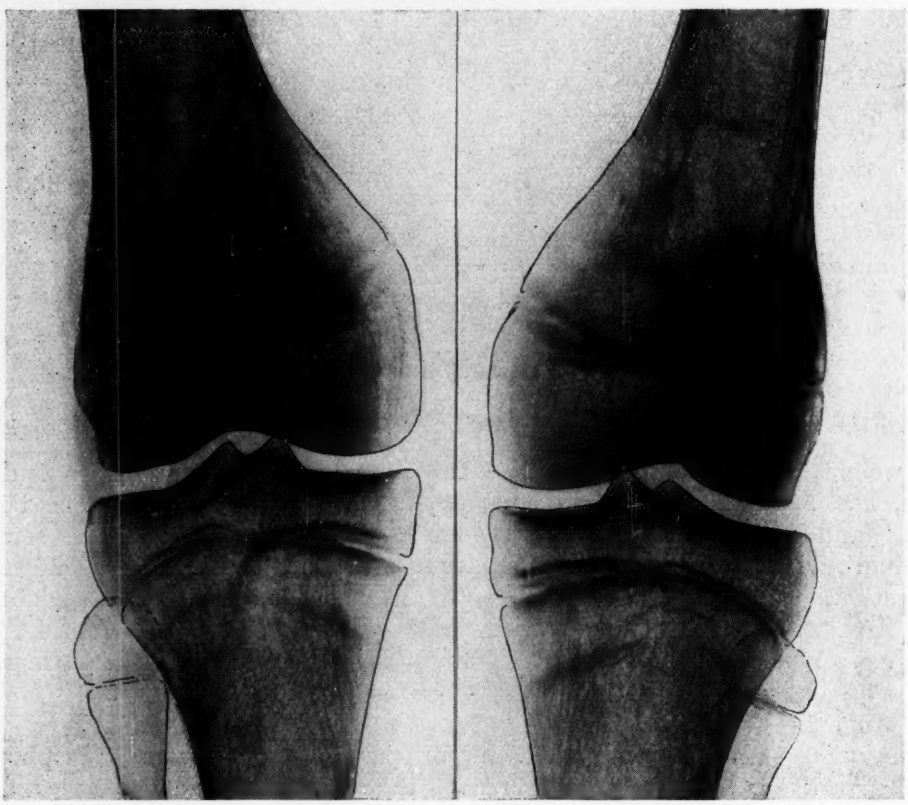


FIG. 344.—X-ray of knees six months after operation. The epiphysial lines are now regular. The bands of increased density at the metaphyses and the early cyst formation in the diaphyses have disappeared.

the two tumours of the mandible, one had completely disappeared, while the other was smaller in size. Radiographic examination of the bones showed that no new cyst formation had occurred, while the cysts previously reported were barely recognizable on the X-ray plate. Moreover, the metaphyses were now practically normal (*Figs.* 342 B, 344).

Biochemical tests also bore evidence of the return to normal metabolism. The serum calcium was 11 mgrm. per 100 c.c. and plasma phosphorus 5 mgrm. per 100 c.c. No abnormal constituents were present in the urine. His urea-concentration test was as follows—percentage of urea in urine: 1st hour,

3·4; 2nd hour, 3·5; 3rd hour, 3·9. Blood-urea 32 mgrm. per 100 c.c. (*Fig.* 345).

No treatment was advised for the one remaining tumour of the mandible, since it was becoming smaller. This small tumour and the cystic areas still faintly visible in the long bones were at this time the only abnormal features still persisting.

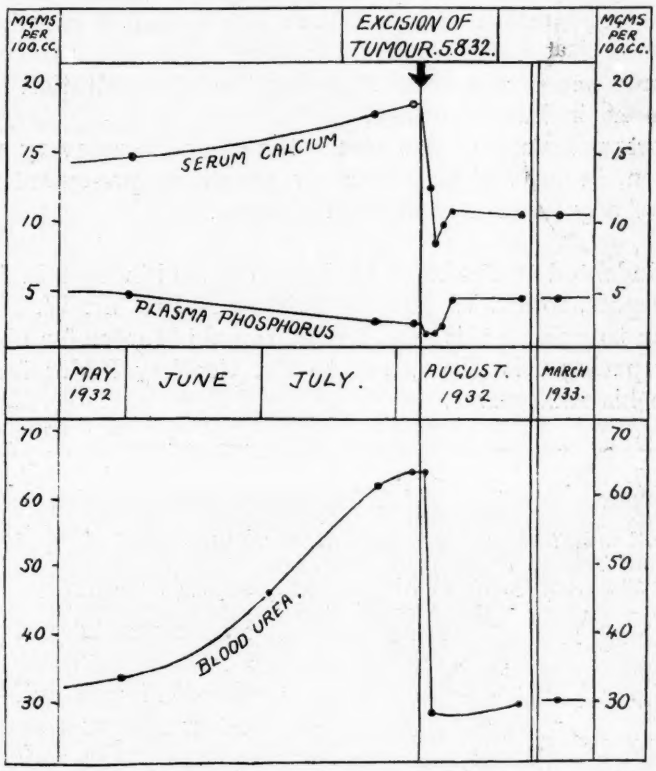


FIG. 345.—Table to show relationship of changes in serum calcium, plasma phosphorus, and blood-urea.

COMMENT.

This case is a well-marked example of hyperparathyroidism occurring at an unusually early age. The usual time of onset, according to Hunter,[1] is between 30 and 55.

The unusual radiographic appearance of a well-defined transverse band of increased density at the metaphyses as an early bone change is probably associated with the presence of active epiphysial growth. This metaphysial change does not appear to have been recorded as a manifestation of hyperparathyroidism with a parathyroid tumour, although Duken[2] in 1928 has reported exactly similar changes and published reproductions of the radiograms in the case of a girl aged 14, diagnosed as late rickets, who subsequently showed the changes of osteitis fibrosa. In his case the blood calcium showed a progressive rise and the plasma phosphorus was low, but at the

time of reporting the case no suggestion had apparently been made of the presence of a parathyroid tumour.

Another unusual feature of this case is the remarkable failure of renal function with the progress of the disease, and its equally remarkable recovery upon the removal of the tumour. This failure of renal function was not associated with the formation of renal calculi, which has frequently been recorded in hyperparathyroidism.

No exact explanation of this failure can be put forward, but it is of interest to note that Hunter and Aub[3] have reported a marked rise of the non-protein nitrogen of the blood following the administration of large doses of parathormone in human beings.

An important feature of this case is the complete recovery of the patient after operation, in spite of his extremely precarious pre-operative state, and the absence of any permanent skeletal changes.

We are indebted to Professor Dudgeon for his kindness in furnishing the histological report, to Mr. W. Rowley Bristow and to Mr. W. H. C. Romanis for permission to publish this case, to Dr. Donald Hunter for his interest and advice in preparing this paper, and to Dr. Geoffrey Fildes for allowing us to reproduce his radiograms.

REFERENCES.

[1] HUNTER, D., *Brit. Jour. Surg.*, 1931–32, xix, 251.
[2] DUKEN, J., *Zeits. f. Kinderheilk.*, 1928, xlvi, 114
[3] HUNTER and AUB, *Quart. Jour. Med.*, 1927, January.

THE OCCURRENCE OF SCROTAL HERNIA IN MICE UNDER TREATMENT WITH ŒSTRIN.

By HAROLD BURROWS,

EXPERIMENTAL PATHOLOGIST, RESEARCH INSTITUTE OF THE CANCER HOSPITAL (FREE), LONDON.

During an experimental inquiry at this institute into the comparative effects of œstrogenic and carcinogenic substances, scrotal hernias have been observed in some of the mice treated with œstrin. The material used was pure ketohydroxyœstrin, for which we are indebted to the generosity of Dr. Girard.

Experiment 1.—Twenty-eight mice were treated twice weekly by the application of a solution (approximately 0·1 per cent in benzene) of œstrin to the non-epilated skin of the interscapular region, by means of a small paint brush. In the course of this treatment a scrotal swelling had been observed in one of the mice by Mr. Woollard while performing his duties of laboratory assistant, and had been reported by him. When the experiment had lasted ten weeks three of these mice had scrotal hernias, bilateral in one and unilateral in the other two—one right and one left.

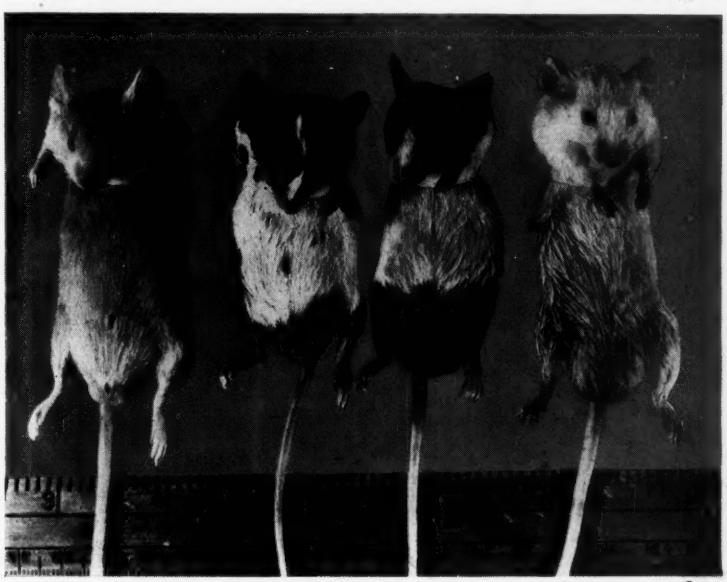


Fig. 346.—Two of the mice treated by subcutaneous injection of œstrin and showing scrotal hernias are on the right, with two normal mice for comparison on the left.

Experiment 2.—During the same period eight male mice were treated with subcutaneous dosage of œstrin in the right groin. During ten weeks five injections were given, each consisting of 0·5 c.c. of a 0·1 per cent solution of ketohydroxyœstrin in olive oil. At the end of this time five of the eight mice were found to have bilateral reducible scrotal hernias (*Figs.* 346–348).

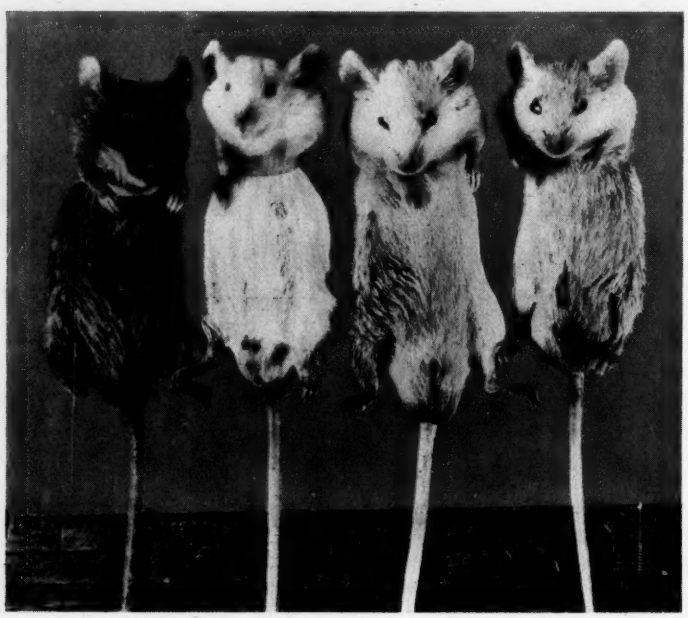


FIG. 347.—Two mice with hernias from the same series of œstrin-treated animals are on the right, with two normal mice on the left. The mice shown in this and the preceding figure are under urethane anæsthesia.

FIG. 348.—Another of the same series of œstrin-treated mice. (This mouse is shown, with the hernia opened, in *Fig.* 350.)

FIG. 349.—Mouse treated with biweekly applications of œstrin (0·01 per cent) to the skin of the back and killed forty-seven days after the first application. Large scrotal hernias are present.

Experiment 3.—Twenty mice were treated in the same way as those in the first experiment except that a more dilute solution of ketohydroxyœstrin was now employed (0·01 per cent in benzene). The experiment was commenced on Aug. 4, 1933. Thirty-five days later six of the thirteen mice still alive had double scrotal hernias, and forty-seven days after the first application of œstrin eleven showed the presence of double scrotal hernias (*Fig.* 349). One of the two mice remaining free from hernia was small and perhaps immature; it weighed only 15 grm. The other was of normal size (25 grm.) and apparently healthy.

Examination of 304 untreated male stock mice, and 276 male mice under treatment of various kinds not entailing the use of œstrin, failed to reveal a single scrotal hernia, nor has this condition in mice been observed on any previous occasion by the author. The results are summarized in the table below.

INCIDENCE OF SCROTAL HERNIA IN MALE MICE UNDER TREATMENT WITH ŒSTRIN.

	METHOD OF APPLYING ŒSTRIN	PERIOD BETWEEN BEGINNING OF EXPERIMENT AND DATE OF OBSERVATION	NUMBER OF MICE SURVIVING AT THE DATE OF OBSERVATION	NUMBER OF HERNIAS
		Days		
Mice Treated with Œstrin—				
Experiment 1	Painted on skin	68	28	3
Experiment 2	Subcutaneous injection ..	66	8	5
Experiment 3	Painted on skin	47	13	11
		Total	49	19
Mice Not Treated with Œstrin—				
a. Six-weeks-old untreated mice			47	0
b. Six-months-old untreated mice			43	0
c. Miscellaneous untreated stock mice ..			214	0
d. Mice under various forms of treatment other than by the administration of œstrin ..			276	0
		Total	580	0

Among the male mice painted with œstrin in the first experiment, the one with a left scrotal hernia died, and the presence of coils of ileum in the scrotum was verified. For further investigation two of the animals treated by subcutaneous injection were killed. In one of these the left half of the scrotum contained the cæcum, while the bladder lay in the right half. The other mouse was preserved as a museum specimen to illustrate the phenomenon. In this animal the cæcum occupied the left half of the scrotum, and coils of small intestine distended the right half (*Fig.* 350). In all these three mice the gut lay in front of the testicles and epididymis, concealing these organs together with the genital omentum, which was small and contained but little fat, in contrast to that of a normal healthy mouse.

DISCUSSION.

A doubt might occur whether mere applications of œstrin in benzene to the non-epilated skin of the back could produce any recognizable effect. The same solution, however, applied twice a week in a similar way to ten female mice, not only kept them in a constant state of œstrus, as tested by the ordinary method of microscopical examination of vaginal smears, but led in every instance to the accumulation in the vagina of a mass of keratinized epithelium sufficiently large to distend the canal, while the uterine cornua became so enlarged as to be readily palpable in the living animal. Ultimately

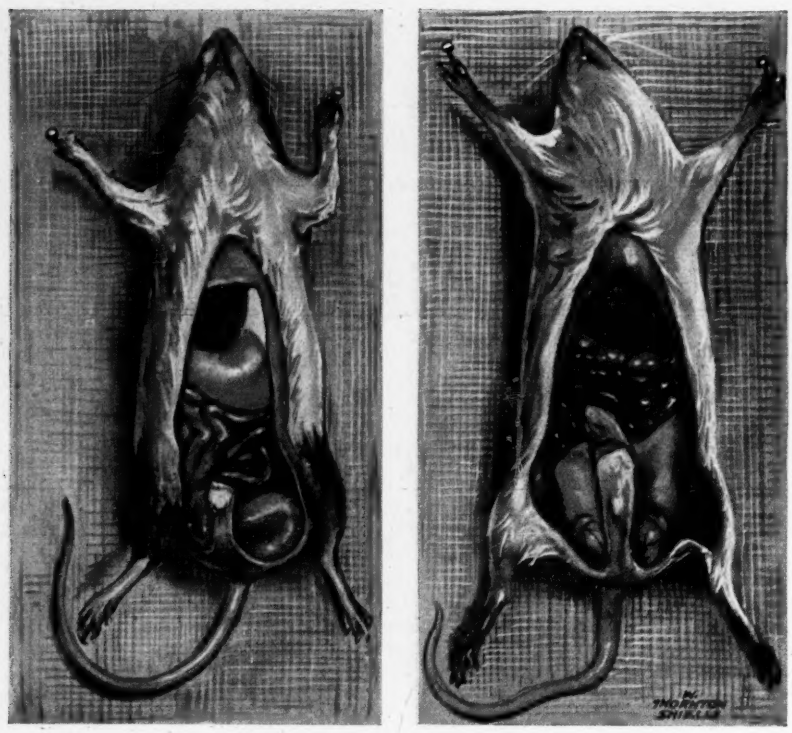


FIG. 350.—The mouse on the left had been treated by subcutaneous injections of œstrin. A double scrotal hernia is shown. The left hernia contains the cæcum, and the right hernia is occupied by small intestine. A normal mouse is shown on the right for comparison. In both mice the scrotal coverings have been slit open through their whole extent, and a mesial strip of skin, including the penis, has been left *in situ*. The band of pale-coloured tissue which extends upward from each testis to the abdomen in the normal mouse is composed of fatty tissue and is spoken of in the text as the genital omentum.

the mice died from pyometra and perimetritis or from urinary obstruction with hydronephrosis. Such results indicate that ketohydroxyœstrin in the medium used is readily taken up through the healthy skin, although the possibility that some may have been inhaled as dust or ingested by the mice licking one another cannot be ignored.

In the mouse, as in the rat, the scrotum is a direct pouch of the peritoneum, and there is no greatly narrowed portion intervening which could well be described as a funicular canal, nor is there any difficulty in

manipulating the testicle into and out of the abdominal cavity. On dissection the aperture between the scrotal pocket and the peritoneal cavity seems so wide as to cause surprise that hernia in these animals does not often occur.

To the eye it may appear at first as though the testicle itself, together with the fatty genital omentum which is attached to the epididymis and spermatic cord and projects upward from this attachment into the abdomen, might perhaps by their bulk form an efficient barrier against the descent of intestine (*Fig.* 350). If this were the only protection against hernia, it would be removed by emaciation. These hernias have not been observed in emaciated mice: nor have they been seen as an accompaniment of ascites. Atrophy of the testicle is one of the consequences of administering œstrin to male mice, and it may be perhaps that the testicular atrophy is favourable to the development of hernia. But it can hardly be a cause, as the occurrence of hernia is an early phenomenon in the conditions now under discussion, and may be present before the diminution in size of the testicle has attained an advanced degree. Again, in rats, whose inguinal anatomy is comparable with that of the mouse, the author has seen extreme atrophy of the testicles without any sign of hernia.

Another point has to be considered. Among the several results of administering œstrin to male mice is an enlargement of the posterior lobes of the prostate with a consequent obstruction to the passage of urine, resulting in distension of the bladder with retention and overflow, and culminating in hydronephrosis.

These prostatic changes were first recorded in a recent paper by Lacassagne,[1] whose observations on the subject we were already prepared to confirm. It might be argued that the scrotal hernias were caused by the accentuated efforts necessary for micturition in these animals. Such a suggestion has little if any force as a complete explanation, seeing that hernia is a relatively early effect of administering œstrin, as shown by the table on p. 509, whereas symptoms referable to enlargement of the prostate and urinary obstruction have not been noted earlier than about the end of the fifth month after the first dose.

Attempts made on healthy mice to cause a protrusion of gut into the scrotum by pressure on the abdomen are unsuccessful. A similar failure attends the manœuvre when attempted on a normal mouse which has been recently killed, although the mesentery is long enough to allow excursion of the gut for the necessary extent. If putrefaction has become well established, on the other hand, coils of gut can be made occasionally to enter the scrotum by pressure on the abdomen.

In view of these facts one is led to believe that hernia is prevented in normal mice mainly or solely by the tonicity of the appropriate muscles, including the panniculus carnosus, which is strongly developed in these animals. The effect of œstrin might be to relax those layers of muscle which regulate the calibre of the passage-way between the abdominal cavity and the scrotum. The phenomenon may be cognate with the well-known fact that in some animals—the stag, for example—the testes descend into the scrotum during the rutting season only, remaining within the abdomen

during the rest of the year. On the other hand, Hisaw[2] found that the administration of an extract of sow's ovary to male pocket-gophers during the breeding season not only caused atrophy of the testicles but caused them to return into the abdomen. Some analogy perhaps may be observed between the production of hernia in male mice by the administration of œstrin and the relaxation of the muscular and ligamentous structures of the pelvis during the later stages of pregnancy when large quantities of œstrin are circulating in the body. In some species, e.g., the guinea-pig, the softening of the pelvic ligaments is of such a degree as to allow a wide separation of the two pubic bones during parturition. Courrier[3] and Brouha[4] have shown that a similar relaxation of the pubic ligaments can be produced in the non-pregnant guinea-pig by the administration of œstrin.

The development of hernia in mice in the circumstances discussed above suggests interesting possibilities in connection with some cases of acquired hernia in man. With a further knowledge concerning hormones it is conceivable that we may be guided toward a method of preventing these lesions, and perhaps some others: abdominal proptosis, for example.

SUMMARY.

Nineteen cases of scrotal hernia were observed in 49 mice under treatment with œstrin.

Examination of 580 mice not treated with œstrin failed to reveal any instance of hernia.

I wish to express my indebtedness to the laboratory assistants both for their care of the animals and for their help in other technical matters.

REFERENCES.

[1] Lacassagne, A., *Comptes. rend. Soc. de Biol.*, 1933, cxiii, 590.
[2] Hisaw, F. L., *Jour. Exper. Zool.*, 1925, xlii, 411.
[3] Courrier, R., *Proc. 2nd Internat. Congress Sex Research*, 1930, London.
[4] Brouha, L., *Comptes. rend. Soc. de Biol.*, 1933, cxiii, 406.

BENIGN GIANT-CELL TUMOUR OF THIRD CERVICAL VERTEBRA: A CASE REPORT.*

By J. A. MacFARLANE and ERIC A. LINELL, Toronto.

A man (A. M.), aged 35, was admitted to the surgical wards of the Toronto General Hospital on Oct. 22, 1931, complaining of severe pain in the neck. On the previous evening he had been cranking the engine of his motor-car, when it backfired. He said that at that instant he was conscious of severe pain in his neck and shoulders. He made his way to his house with some difficulty. The pain continued and he passed a sleepless night.

Examination showed that he held his head and neck rigidly and that there was a moderate swelling in the mid-cervical region. Any attempt at movement caused severe pain. X-ray examination carried out shortly after his admission revealed a compression fracture of the body of the 3rd cervical vertebra, collapse apparently having taken place in the middle of the body, as there was very little evidence of change in its anterior aspect. The spaces between the 3rd and 2nd and the 3rd and 4th vertebræ were normal in width. No evidence of any disease could be seen in the adjacent vertebræ (*Fig.* 351).

Fig. 351.—X-ray of patient's cervical spine taken on admission to hospital, Oct. 22, 1931, showing fracture of body of 3rd cervical vertebra.

From the history of the injury it seemed highly improbable that a simple traumatic compression fracture could have been produced in such a manner, and it was suspected that there must have been some pre-existing disease in the bone involved.

General physical examination was negative. No defect could be noted elsewhere in his osseous system. The function of his gastro-intestinal system was apparently normal and there was no history of loss of weight or failure of appetite. The thyroid was not enlarged. Rectal examination showed a normal prostate and there was no history of disturbance of urinary function.

* From the Department of Surgery and the Division of Neuropathology, University of Toronto.

The man was treated by head extension on a Bradford frame, and as long as moderate extension was applied, he remained reasonably comfortable. At the end of ten days he developed a low-grade bronchopneumonia, from which he had recovered at the end of three weeks from the date of his admission. At this time the pain was considerably relieved and further investigations were carried out. A complete X-ray examination of the skeleton showed no sign of disease elsewhere. His urine was examined for blood and other abnormal findings, with negative results. X-ray examination showed the kidneys to be normal in size and position. Cystoscopy and pyelography were not carried out. Radiological investigation of the gastro-intestinal tract was undertaken and no evidence of new growth was found in stomach or colon. X-rays of the chest showed no evidence of intrapulmonary disease. A second plate of the cervical spine was made on Nov. 19 (*Fig.* 352), and this was compared with the previous plate and reported upon by the Radiological Department of the hospital as follows: "The upper part of the 3rd cervical vertebra has disappeared and there appears to be slightly more angulation at this examination than previously. No involvement of other vertebral bodies could be noted. Diagnosis at this time radiologically rests between primary or secondary new growth."

FIG. 352.—X-ray taken on Nov. 19, 1931. Shows extent of destructive changes in the body of the affected vertebra. There is evidence of angulation of the cervical spine.

Consideration of the facts of the case up to this date seemed to favour the diagnosis of a giant-cell tumour. As has already been noted, there was neither clinical nor radiological evidence of primary new growth found in the gastro-intestinal tract, prostate, kidneys, or thyroid. There was no evidence clinically or radiologically that the man was suffering from osteomalacia, Paget's disease, or osteomyelitis. The possibility of a multiple myeloma with this lesion as the primary growth had to be considered, but one would have expected that evidences of similar disease elsewhere would be present at the end of four weeks. Chronic inflammatory disease of a tuberculous nature was also a possibility, but it has been pointed out that there was still no evidence of encroachment on the adjacent intervertebral discs. Syphilis was ruled out by a negative Wassermann reaction in blood and spinal fluid. Giant-cell tumour was, consequently, maintained as a working diagnosis, and it was thought unwise, on account of the inaccessibility of the lesion, to attempt the operative removal of tumour tissue merely for the purpose of confirming the diagnosis. The patient was therefore given deep X-ray therapy by the Radiological Department of the hospital. At the end of six weeks the upper part of his

trunk, the cervical spine, and the head were immobilized in a plaster jacket, and six weeks later he was allowed to go home. At this time he was reasonably comfortable except for pain which radiated to his shoulders if he remained erect for long periods. *Fig.* 353 shows the X-ray appearances on Dec. 18, 1931.

FIG. 353.—Further changes as seen on Dec. 18, 1931.

He remained at home for six weeks, and then returned to hospital for the removal of his plaster. Inspection now revealed a shortening of his neck, giving him a 'bull-neck' appearance. The nasopharynx was increased in depth and he had a slight degree of voice change. X-rays at this time, Feb. 25, 1932 (*Fig.* 354), showed further collapse of the vertebra, but there was still no evidence of encroachment on the intervertebral discs or adjacent vertebræ. He was measured for a special celluloid supporting collar, with which he was allowed to go home on March 9.

Subsequently the patient was followed in the Out-patients' Department and X-ray examination was carried out at monthly intervals On each examination a little further destruction of the body of the vertebra was observed, until finally on June 22 (*Fig.* 355) only a small wisp of bone could be seen in the X-ray plate and still there was no evidence of encroachment on the adjacent structures. The man during this period was putting on weight, felt very well, and was anxious to go to work. He was allowed to return to work on June 27, and his company, rather than send him back to ordinary duties, allowed him to drive a small pony cart which was used for advertising purposes. When about to alight from the rear of this cart, the pony started suddenly and threw him off in such a manner that he struck his head violently on the pavement. He was taken in an unconscious

FIG. 354.—X-ray taken on Feb. 25, 1932. Shows well-marked angulation at site of diseased vertebra, also the well-marked backward convexity of the posterior pharyngeal wall.

condition to another hospital, where he was seen two hours later, obviously about to die. He was moribund and it was impossible to determine on physical examination whether he was dying from intracerebral injury entirely, or whether he had suffered a severe cord lesion from dislocation. He died a short time afterwards and permission to obtain the cervical spine was granted by the coroner's pathologist. Considerable difficulty was encountered in removing this without damage, and the fresh fracture, noted in the pathological report, at the end of the left lamina of the 3rd cervical vertebra may have been caused by this manipulation. There was gross evidence of a fractured skull with extensive intracranial hæmorrhage, and this would seem to have been the immediate cause of his death.

FIG. 355.—X-ray appearances as seen on June 22, 1932.

AUTOPSY.—The post-mortem examination revealed a fracture of the cranial base with laceration of brain tissue. The cervical spinal column was removed with its surrounding muscles.

The excised portion of the vertebral column was sawn sagitally, and examination of the cut surfaces revealed almost complete absorption of the body of the 3rd vertebra, there being only a small area of necrotic tissue intervening between the fibrocartilage at the distal end of the axis and that on the upper surface of the 4th cervical vertebral body (*Fig.* 356 B). The intervertebral disc of the distal surface of the axis had a convex inferior surface. The body of the axis formed, with the body of the 4th cervical vertebra, an angle of 145° opening forwards. The backward dislocation of the axis had narrowed the antero-posterior diameter of the spinal canal to 1 cm. and had caused compression of the spinal cord. The dura mater ventral to the spinal cord at the level of maximum compression showed some thickening. There was no evidence of hæmorrhage into the membranes or into the subarachnoid space. Petechial hæmorrhages were visible in the spinal cord at its point of compression.

Examination of the external surface of the left half of the specimen showed a fresh fracture at the lateral end of the lamina of the 3rd cervical vertebra (*Fig.* 356 A). The lateral mass of this vertebra was practically completely destroyed, its place being taken by a necrotic cavity. No trace of the dorsal primary division of the left 3rd cervical nerve could be seen. *On the right side* a large area of the lateral mass of the 3rd cervical vertebra was replaced by soft necrotic tissue, and this tissue filled the space between the axis and 4th cervical vertebra. The 3rd cervical nerve was present and apparently normal on the right side.

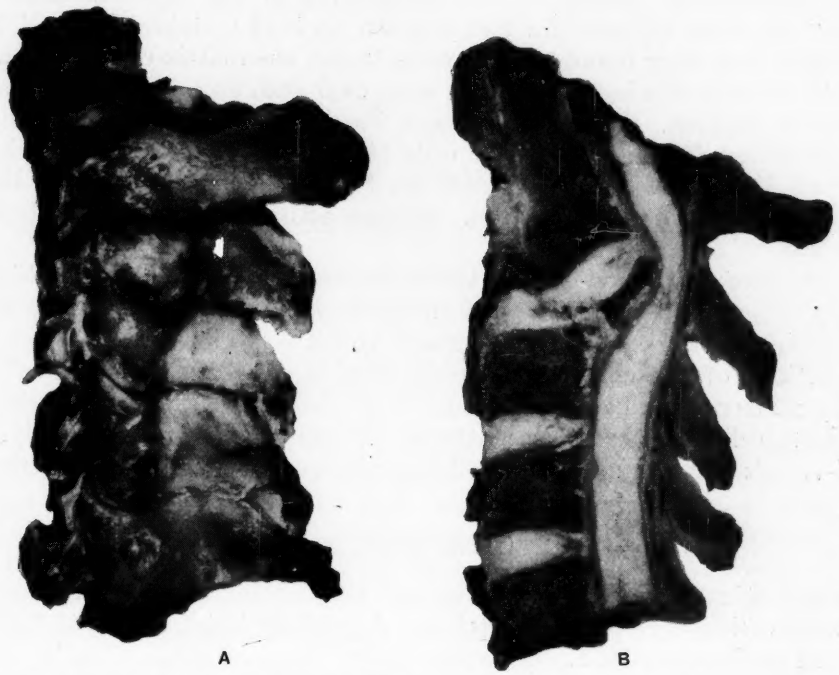


FIG. 356.—A, Lateral view of left half of cervical spinal column showing: new fracture of lamina of 3rd cervical vertebra and absorption of the body of this vertebra with forward angulation of the column above this point. The tumour tissue was removed from the hole seen in the 3rd cervical vertebral body. No trace of the dorsal division of the 3rd cervical nerve could be found. B, Mesial surface of the right half of the cervical spinal column showing almost complete absorption of the body of the 3rd cervical vertebra with backward dislocation of the axis and severe compression of the spinal cord. Tumour tissue was found just above the upper border of the body of the 4th cervical vertebra.

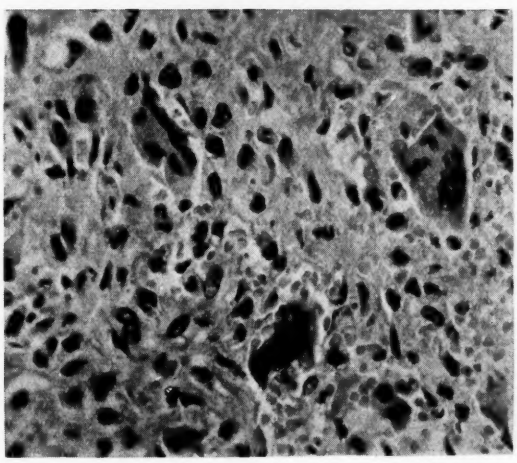


FIG. 357.—A typical low-power field taken to show a stroma of bipolar cells among which are seen three foreign-body giant cells typical of benign giant-cell tumour of bone. In the neighbourhood of the giant cell in the lower part of the field red blood-corpuscles can be seen lying free in the tumour tissue.

MICROSCOPICAL EXAMINATION.—Fragments of the necrotic tissue were scooped out from between the 2nd and 4th cervical vertebral bodies. Microscopically these were found to be tumour tissue, the matrix of which consisted of fusiform cells of which the nuclei were oval and, as a rule, showed a light chromatin content. Scattered through the tumour were large numbers of multinucleated foreign-body giant cells (*Fig.* 357). There were numbers of thin-walled blood-vessels throughout the tumour and a considerable amount of free hæmorrhage could be seen. A diagnosis of benign giant-cell tumour was made.

The dura mater ventral to the compressed spinal cord was thickened and contained a few collections of small round cells. There was no sign of infiltration of the membrane by tumour tissue.

Sections of the compressed spinal cord showed the two ventral horns of grey matter to be flattened and to lie in close apposition with each other. The nerve cells and the white matter of the cord stained satisfactorily. The blood-vessels were congested, but there was no evidence of hæmorrhage.

CONCLUSIONS.

The patient had a benign giant-cell tumour involving, and limited to, the body of his 3rd cervical vertebra. A pathological fracture of this bone occurred in October, 1931.

By a correlation of the clinical, radiographic, and post-mortem pathological findings, we are of the opinion that the backward dislocation of the axis and the compression of the cord increased gradually from the time of the pathological fracture to his death on June 27, 1932, and that his terminal injury was not responsible for the displacement of his cervical spine as revealed at the post-mortem examination.

The radiological investigation was performed by Dr. A. C. Singleton, of the Toronto General Hospital. We are indebted to Dr. George Laughlen, of the Toronto Eastern General Hospital, for his permission to examine the pathological material of the case and to publish this report.

ADENOPAPILLOMA OF THE STOMACH ASSOCIATED WITH LYMPHOID HYPERPLASIA OF THE DUODENUM.

By A. E. WEBB-JOHNSON,
SURGEON TO THE MIDDLESEX HOSPITAL;

AND E. G. MUIR,
SURGICAL REGISTRAR, THE MIDDLESEX HOSPITAL.

Benign tumours of the stomach are still sufficiently rare to be regarded as clinical curiosities. Eliason and Wright[1] collected 560 cases from the literature and added 50 cases of their own, but the great majority of these were only found at autopsy. Eusterman and Senty,[2] in a review of cases at the Mayo Clinic, found that only 0·5 per cent of gastric neoplasms were benign. The published figures show that, of benign tumours of the stomach, myoma is found somewhat more frequently than papilloma. Associated lesions are present in many of the cases. Thus Balfour and Henderson[3] found other lesions, such as ulcer or carcinoma, present in 22 out of 58 cases of benign gastric tumour.

The following case is of interest in that it was diagnosed before operation by the radiologist, Dr. Beath, of Belfast, and was associated with lymphoid hyperplasia of the first part of the duodenum, sufficiently marked to give rise to multiple small polypi.

CASE REPORT.

History.—The patient, a man of 72, complained of epigastric pain of eighteen months' duration. The pain was at first intermittent, but later became continuous and was made worse by food. Temporary relief was obtained by alkaline powders. The patient had suffered from constipation and believed that he had lost weight.

Opaque Meal Examination (Dr. Beath).—

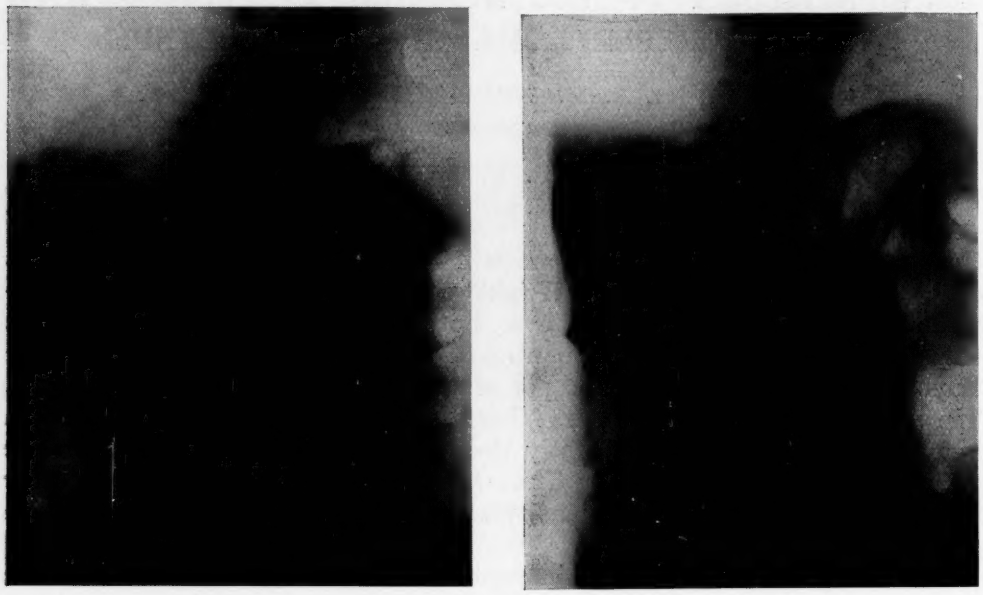
1. *Immediately After Meal* (*Erect*).—The stomach is normal in outline except at the extreme pyloric end, where there is a clear area, well defined and 'punched-out' looking. This is constant and can be seen on screening at all angles. Muscular tone is good and peristalsis normal. The duodenal cap fills readily and appears normal in outline. Initial emptying is at normal rate.

2. *Immediately After Meal* (*Prone*).—Confirms the above appearances in this position.

3. *Six Hours After Meal* (*Erect*).—The stomach is empty. There is a moderate degree of ileal stasis, with normal motility in the colon. The appendix is visible and looks normal.

4. *Twenty-seven Hours After Meal* (*Erect*).—There is considerable delay in the large intestine, which is spastic.

Findings.—There is a quite definite 'filling defect' (*Figs.* 358, 359) at the pyloric end of the stomach, but this does not present the usual appearances of a carcinoma. It is more suggestive of a papilloma growing from the



FIGS. 358, 359.—Barium meal showing 'filling defect' at pylorus.

FIG. 360.—Resected portion of stomach showing adenopapilloma with hyperplastic lymph follicles of duodenum.

stomach wall. It would be impossible to discriminate definitely between the two possibilities, other than by a laparotomy.

Operation (May 10, 1932).—Laparotomy was performed and the stomach examined. A tumour could be felt at the pyloric end and partial gastrectomy was performed.

The patient made an uninterrupted recovery, and in February, 1933, reported that he was free from symptoms and was still gaining weight.

Pathological Report.—The specimen consists of 3½ in. of stomach with a small piece of the duodenum (*Fig.* 360). Growing from the posterior wall of the stomach is an oval tumour, some 2 in. in length, with a short, broad base. There is no infiltration of the gastric wall nor any other lesion in the stomach. The duodenal mucosa on the posterior wall shows, just distal to the pylorus, a number of small polypoid processes, the largest being ⅓ in. in diameter.

Histology.—Sections of the gastric tumour show an adenopapilloma with no evidence of malignancy. The small duodenal polypi consist of hyperplastic lymph follicles covered by mucosa.

COMMENTARY.

In the majority of cases the radiological diagnosis of such a condition as benign gastric tumour will be a tentative one, although in X-ray films we have examined of proved cases the appearances seem very similar and unlike carcinoma or ulcer. Moore,[4] from a study of the radiological findings in 23 cases of benign tumour, concluded that these cases manifest certain signs which, if not definitely diagnostic, are at least suggestive. The stream of barium, as it enters the stomach, may be split in two by a tumour growing from the posterior wall. The filling defect is circumscribed and usually on the posterior wall. There is little or no disturbance of peristalsis except in those at or near the pylorus, nor is there any niche, incisura, or spasm.

In two cases described by Moore[4] a " central, cyst-like filling defect was present in the duodenal cap ". These were diagnosed as duodenal tumours, but at operation were found to be gastric growths which had prolapsed through the pylorus.

The pathological condition of the duodenum in this case is interesting, and in the reported cases of benign gastric tumour we do not find it mentioned as an associated lesion.

While there was no radiological evidence of prolapse in this case, the close proximity of the tumour to the pylorus suggests that intermittent prolapse, with irritation of the duodenal mucosa, may have been an etiological factor in the production of the lymphoid hyperplasia.

Partial gastrectomy would appear to be the most suitable method of treating benign gastric tumours. Balfour and Henderson[3] described a series of cases in which the procedure used most frequently was transgastric excision through an incision in the anterior wall, and division of the pedicle by cautery, while partial gastrectomy was reserved for the larger tumours. They record one case in which carcinoma developed at the site of attachment of the pedicle.

Ewing[5] believes that a number of cases of gastric carcinoma arise in adenomata. Since it is not possible to gauge the degree of malignancy of a tumour from a naked-eye examination, partial gastrectomy would appear to be the method of choice.

Our thanks are due to Dr. Beath, whose radiological report has been quoted verbatim, and to Professor James McIntosh for the use of pathological material.

REFERENCES.

[1] ELIASON, E. L., and WRIGHT, V. W. M., *Surg. Gynecol. and Obst.*, 1925, xli, 461.
[2] EUSTERMAN, G. B., and SENTY, E. G., *Ibid.*, 1922, xxxiv, 5.
[3] BALFOUR, D. C., and HENDERSON, E. F., *Ann. of Surg.*, 1927, lxxxv, 354.
[4] MOORE, A. B., *Amer. Jour. Roentgenol.*, 1924, xi, 61.
[5] EWING, J., *Neoplastic Diseases*, 671.

SPONTANEOUS DISLOCATION OF THE HIP IN CHILDHOOD.

By P. N. RAY,

HON. SURGEON, CARMICHAEL MEDICAL COLLEGE HOSPITALS, AND ADDITIONAL SURGEON, HOWRAH GENERAL HOSPITAL, CALCUTTA.

Spontaneous dislocation may occur in any acute arthritis of the hip-joint as a complication. Cases[1] are recorded of dislocation in typhoid fever, rheumatism, scarlatina, and other exanthemata, as a result of acute non-suppurative infective arthritis. The following case is of interest on account of its occurrence during an attack of bacillary dysentery and its unusual termination.

CASE REPORT.

B. B., a Bengali female child, aged 6, was examined by me in consultation in December, 1931.

History.—The patient had a severe attack of bacillary dysentery in June, 1931. During convalescence several joints were affected by dysenteric synovitis. At first the left knee-joint became swollen, but within the next four or five days the right ankle, the right hip, and the left elbow were also involved. It took nearly six weeks before the effusion of the joints subsided, but the right hip-joint remained very painful and the patient was almost crippled and confined to her bed. In the other joints recovery was complete.

Fig. 361.—Before commencement of treatment: the acetabular fossa is occupied by an osteophytic mass.

There was no history of any serious illness, or of any disability regarding the right hip-joint. She was a very healthy and bright child.

On Examination.—The deformity of the right hip-joint was characterized by flexion and adduction, but muscle spasm was not marked. The head of the femur was palpable over the gluteal region. There was marked limitation of movement in all directions, and all movements were painful. There was also pronounced wasting of the hip and thigh muscles. On measurement the shortening of the affected limb was found to be fully an inch. No abnormality could be detected in other joints. The patient was unable to stand or walk.

The general health was very poor and she was reduced to a mere skeleton. The diagnosis of dorsal pathological dislocation was made. Reaction of degeneration, negative.

Skiagraphy.—The head of the femur presented no abnormality and there was practically no destruction of bone. The acetabular cavity was very shallow owing to the presence of an osteophytic mass (*Fig.* 361).

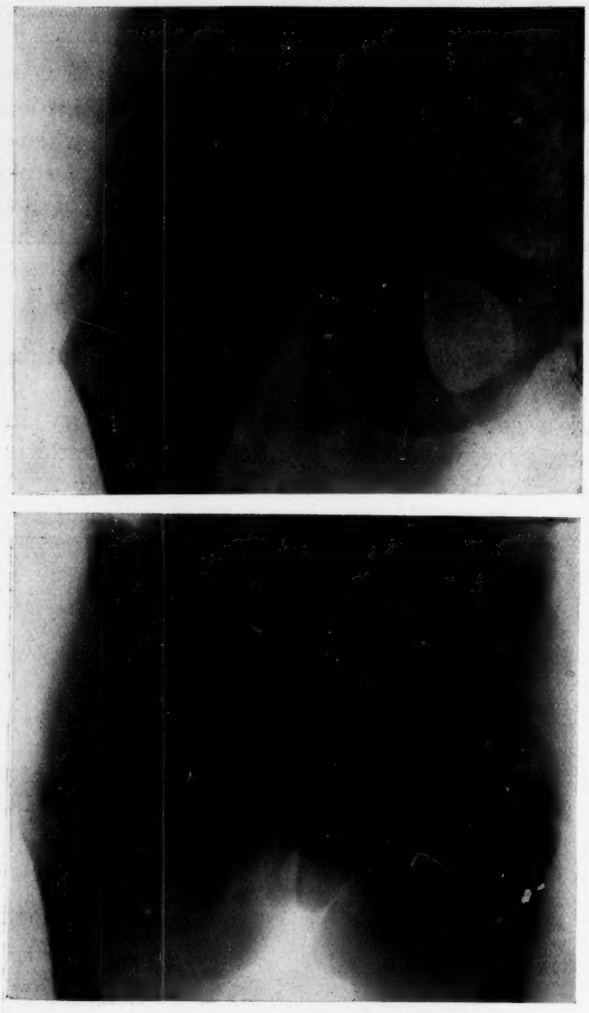


FIG. 362.—Nine weeks after removal of plaster casing: showing the position of the femoral head and the shallowness of the acetabular fossa.

TREATMENT.—

1. *Local Treatment.*—The dislocation was reduced by the Lorenz method and kept immobilized in plaster-of-Paris. The patient was kept in bed for a fortnight and then she was encouraged to stand and walk with a high boot on the affected side. After eight weeks the casing was removed, and on examination the femoral head was found to lie in correct position and there was no tendency to recurrence of dislocation. A fresh plaster, however, was put on, but flexion was reduced to about 15° and abduction to 25°, and it was retained for eight weeks. The total period of fixation in plaster was four months. At the end of this period little difficulty was experienced in bringing the limb down to the normal position. The stability of reposition was maintained.

2. *General Treatment.*—The child was sent away to the country for a change of air, and other hygienic and dietetic measures were undertaken for the improvement of the general health.

PROGRESS OF THE CASE.—After removal of the plaster casing, modified Thomas walking caliper splints were provided for six months for weight-bearing and walking on account of muscular wasting and weakness of limb. Massage and passive movements were continued throughout the period of treatment. At the end of one year muscular wasting was nearly made good.

During this prolonged period of treatment the affected hip-joint was examined under the X rays several times (*Fig.* 362). The latest skiagram (January, 1933) showed that the osteophytic outgrowth was so much reduced in size that the femoral head could be accommodated within the acetabular cavity (*Fig.* 363).

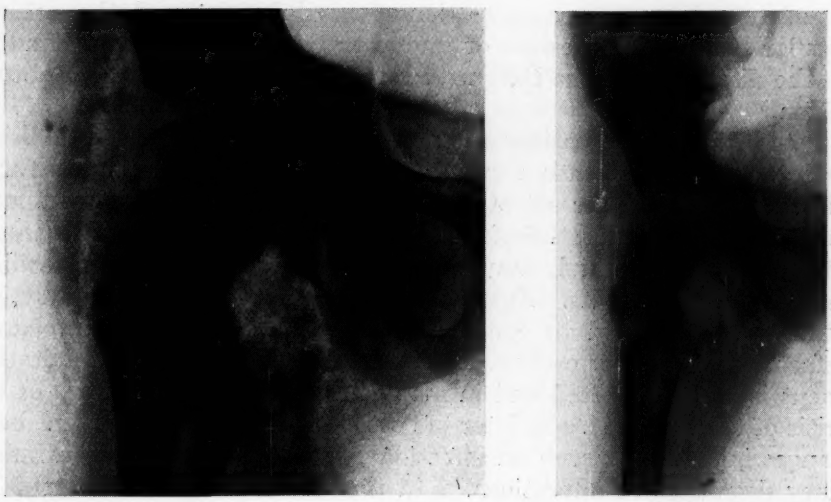


FIG. 363.—One year later: showing retrogression of the osteophytic outgrowth and lodgement of the femoral head within the acetabular fossa.

RESULT.—A mobile joint has been obtained and it is now completely free from pain. The final range of mobility is as follows: on flexion, the thigh forms an angle of about 20° with the abdomen; extension 25° beyond the long axis of the body; abduction 30° in the coronal plane; external rotation is slightly restricted; internal rotation and adduction are almost as good as on the healthy side. The limb can be easily placed in the 'tailor's position'. The patient walks without a limp.

COMMENTARY.

In attempting to arrive at a diagnosis of the condition, the possibilities which had to be considered were: (1) Congenital dislocation of the hip; (2) Infantile paralysis; and (3) Traumatic dislocation. The diagnosis was confirmed by the history of the case, skiagraphy, and electrical reactions of the wasted muscles. I have since seen one other case of spontaneous dislocation of the hip after non-suppurative typhoid arthritis in a girl of 3. The onset was insidious. The dislocation was reduced easily in this case. Dysenteric rheumatism or synovitis is said to be common in some epidemics, but the condition usually clears up without leaving any permanent deformity, though exceptionally permanent disability may result.[2]

Regarding the mechanism of the dislocation, emphasis has been laid on the over-distension of the joint cavity[3] and the rupture of the capsule.[1] It is an interesting fact that in a case like the one described above, the

dislocation occurs very rapidly when there is marked flexor and adductor spasm. It has been pointed out that the pathological dislocation is caused by the derangement of the balanced action of muscles surrounding the hip-joint, as a result of muscle spasm and unequal distribution of muscle atrophy.[4] Flexion, adduction, and internal rotation of the hip should therefore be considered a dangerous attitude. It is clear that the preventive treatment consists of early correction or prevention of this deformity with the restoration of muscular balance. Excessive or undue traction, on the other hand, may lead to the disruption of the softened ligaments and give rise to an obturator dislocation.[5]

The treatment of a patient after the deformity has been established is unsatisfactory, and frequently the luxation is a minor deformity compared to the associated deformities of other joints.[6] Therefore early manipulative treatment is essential for satisfacfory restoration of function. Too early interference, on the other hand, may flare up a quiescent infection, leading to more serious complications. Forcible manipulation may cause a fracture of the femur. With regard to complete restoration of function, prognosis is unsatisfactory. However early reduction is accomplished, some limitation of movement is to be expected and in many instances bony ankylosis or osteochondritis of the hip-joint. In later life osteo-arthritis may supervene because the changes initiated by such an infection of the joint may be continued by secondary degenerative alterations.[7] In the case described above the incidence and retrogression of an osteophytic mass may be regarded as unusual. Generally the condition tends to be progressive.

SUMMARY.

1. A case of spontaneous dislocation of the hip following acute non-suppurative dysenteric synovitis has been described.

2. A painless mobile and stable joint has been obtained by manipulative reduction and immobilization in spite of the presence of a large osteophytic mass within the acetabular cavity.

3. After one year the osteophytic outgrowth has been so much reduced in size that the femoral head has been successfully accommodated inside the acetabular cavity.

I wish to thank Mr. Elmslie for his kind and helpful suggestions.

REFERENCES.

[1] WHITMAN, R., *A Treatise on Orthopædic Surgery*, 1930, 9th ed., 420. London: Henry Kimpton.
[2] MANSON-BAHR, P., Manson's *Tropical Diseases*, 1929, 388. London: Cassell & Co.
[3] CHOYCE, C. C., *System of Surgery*, 1925, iii, 982. London: Cassell & Co.
[4] JONES, R. W., *Brit. Jour. Surg.*, 1926, July, 36.
[5] ROMANIS, W. H. C., and MITCHINER, P. H., *The Science and Practice of Surgery*, 1930, 3rd ed., i, 606. London: J. & A. Churchill.
[6] HART, V. L., *Arch. of Surg.*, 1928, Oct., 587.
[7] ELMSLIE, R. C., *Brit. Med. Jour.*, 1933, i, 1.

TWO CASES OF KELOID FORMATION, WITH COMMENTS.

By C. E. L. BURMAN, Pietermaritzburg.

An unusual case of keloid reported by Professor Rutherford Morison[1] in 1920 is of special interest because it has been possible to follow developments for the last twelve years with the present condition of a case of recent date. (*Figs.* 364, 365.) The clinical characters are so similar that a possible theory as to the causation of the keloid condition, in the light of recent knowledge, is suggested.

Fig. 364.—Rutherford Morison's case, 1933.

Fig. 365.—Present case.

Professor Rutherford Morison said: "Keloids are interesting growths and require further research work to be expended upon them, because they form a link between the infectious and malignant growths. They possess a local malignancy so pronounced as to make it almost certain that in this case there will be recurrence of the growth which has been for the time so successfully removed. We also know that they are associated in some way with

sepsis and tubercle of chronic type; that on the skin, burn scars, which take a long time to heal, and scars resulting from tubercle, are their sites; and they are more common in the black than in the white races."

In an article "Observations and Reflections on Cancer in General Practice", utilizing this case, I stated:[2] "Clinically, he undoubtedly possessed that 'something' so essential to the manufacture of good, sound fibrous tissue, and which, at present, is the secret of nature in deciding the degree of malignancy of a growth. The development of good, sound fibrous tissue is always absent in the cancers which we recognize as extremely malignant, and recurrence is rapid. On the other hand, where the patient possesses the biochemical properties of producing good, sound fibrous tissue, the growth is always slow growing and of the scirrhus type. I am of opinion that it would be impossible to produce an external cancer in this native, so good are his fibrous forming properties. Chronic irritation in him produces no cancer cells, but active proliferating connective tissue cells, and yet removal is followed by local recurrence."

The present case of keloid, seen on Feb. 12, 1932, gave the following history:—

Well-built native, aged 30 years. Vaccinated at the age of 10 years. His ears, as is the native custom about puberty, were perforated so that ornaments could be inserted or carried in the openings. Shortly afterwards the growth of the lobe of the right ear started and slowly enlarged. In 1925 the growth, then about the size of a pigeon's egg, was removed, and owing to its return and increase of size it was again removed in 1929.

He consulted me with a view to further removal on account of severe itching and increase of the size since removal in 1925. Keloid growths were evident on the lobe of the right ear, under the chin, forehead, chest, on both arms in the region of the elbows, and on other parts of the body.

In 1926 he fell off his bicycle and scraped both arms. In 1929 he was attacked by other natives, and wounds (which were stitched) were received on the forehead and chest. In April, 1931, he was injured on the back of the head, and in November of the same year on the forehead.

On the back there were six scarifications which he says were done during infancy but showed no signs of keloid formation, and a thin papery scar on the outer side of the right leg, the result of a tear from barbed wire before he reached puberty.

In both this case and that reported by Rutherford Morison similar manifestations are evident: (1) Vaccination marks and scarifications produced before puberty show no keloid formation unless as rare exceptions; (2) Marked distension of the veins of the extremities; (3) Local recurrence after removal, with increase of size of growths; (4) Slow progress of growths where removal has not been carried out; (5) Injuries after puberty are followed by keloid growths; (6) No organic disease is evident other than the growths; (7) The enlargement of the penis; (8) Sepsis is present in the growths where surgical removal has been undertaken, and in Morison's case is slowly producing wasting, malnutrition, and a miserable existence.

Keloid formation is undoubtedly more common in natives and those with pigmented skins. The development of the medullary portion of the adrenal glands with the sympathetic system and their association with the connective-tissue cells of the skin, and more especially the layer of the stratum granulosum containing eleidin, the forerunner of the keratin of the stratum lucidum, may have some bearing in bringing about, at puberty, over-stimulation of these cells, with consequent overgrowth when a wound is produced and healing is necessary.

In Addison's disease we have disease of the medullary portion, with consequent loss of stimulation, but pigmentation. Similar analogies can be noted in disease of the thyroid, parathyroid, pituitary, and other glands with an internal secretion controlled by the sympathetic.

My thanks are due to Professor Rutherford Morison for permission to utilize his case; to Dr. Pinniger, of Ladysmith, Natal, for referring the present case; and to Sergt. Andersen, of the C.I.D. of Maritzburg, for the reproduction of the photographs.

BIBLIOGRAPHY.

[1] Morison, R., *Brit. Jour. Surg.*, 1920, vii, 538.
[2] Burman, *Med. Assoc. S. Africa*, June 13, 1931.
Schafer, *Essentials of Histology*, 1929, 12th edition.
Fraser, *Manual of Embryology*, 1931.
Ewing, *Neoplastic Diseases*, 1928.

ACUTE INFECTIVE OSTEOMYELITIS OF THE TIBIA: USE OF WINNETT ORR TECHNIQUE.

By M. G. O'MALLEY,

PROFESSOR OF SURGERY, UNIVERSITY COLLEGE, GALWAY.

The value of the Winnett Orr method in the treatment of compound fractures and chronic osteomyelitis is generally recognized; but apparently its application in acute osteomyelitis has not found favour in this country if one is to judge from recent text-books and publications.

At the Central Hospital, Galway, during the years 1930–32, 17 cases of acute infective myelitis of the tibia, out of a total admission of 31, were treated by the Winnett Orr method. Some of the cases were of a very severe type, two being complicated by septic arthritis of the ankle-joint.

There were 4 deaths in the whole series of 31 cases. Three deaths occurred in the 14 treated by open drainage, and there was one death in the 17 treated by the Winnett Orr technique. These figures are not given to prove the life-saving value of the latter method. Of the 3 fatal cases treated by open drainage, one, a boy aged 4½ years, died on the day following admission; another, a boy aged 10, died on the second day; and the third, a boy aged 8, died on the sixth day after operation. Two of the cases were moribund on admission, the other case might have been saved by an amputation, for which the consent of the relatives could not be obtained. The fatality among those treated by the Winnett Orr method was a boy aged 9 years, who died on the seventh day following operation. An amputation would have been more appropriate in this case.

A review of the 16 successful cases treated according to the Orr technique showed that an average of three dressings were necessary. The first dressing was usually left untouched for eight weeks. The subsequent dressings became rather intolerable in four weeks, and in many cases even earlier. The stench is never so pronounced in the acute as in the chronic cases.

Patients who come from good homes are treated as out-patients at the end of a week. The majority, however, come from poor out-lying parts of the county, and we find it necessary to detain them in hospital until healing is complete. The rural slums on the western seaboard provide us with many victims where home treatment is impossible.

Brief details of four of the more serious cases are given below:—

Case 1.—M. L., female aged 13 years, admitted to hospital on June 14, 1931. Acute osteomyelitis of the left tibia with septic arthritis of the ankle. Temperature 102°, pulse 124. Mildly delirious.

The lower three-fourths of the tibia were opened up and incisions were made into the ankle-joint. The wounds were packed with vaseline gauze and plaster-of-Paris was applied. Temperature and pulse were normal on the third day, and there was no pain after the second day. This case required redressing on the sixteenth day owing to the return of pain and temperature. Convalescence was smooth after the second dressing. Four dressings were required in all. The wounds were finally healed on Nov. 7. The result was excellent, with good function in the ankle-joint.

Case 2.—W. N., female aged 11 years, admitted on Nov. 17, 1931. Temperature 104°, pulse 120. Extensive involvement of the left tibia and ankle-joint. The whole of the shaft of the tibia was opened up and several incisions were made into the ankle-joint. Temperature and pulse returned to normal on the third day and the subsequent course was uneventful. Three dressings were required. The wounds finally healed on Feb. 21, 1932. This was a particularly gratifying result.

Case 3.—J. O. T., male aged 5 years, admitted on Dec. 9, 1931. Temperature 102°, pulse 120. Involvement of the whole of the tibial shaft with an abscess pointing in the popliteal space. An incision was made in the popliteal space and the abscess traced down along the inner side of the knee to the upper end of the shaft of the tibia. The shaft of the tibia was opened up in its whole length. The wound in the soft tissues extended from the popliteal space to the ankle. Temperature and pulse returned to normal after the fifth day. The wound finally healed on June 2, 1932. This case required five dressings.

Case 4.—M. R., male aged 7 years, admitted on Feb. 5, 1931. Temperature 103°, pulse 140; very ill. The whole of the shaft of the tibia was involved. Winnett Orr technique. Temperature and pulse normal on the sixth day. The wound finally healed on July 14. Four dressings were required.

Every case of the 16 under review required extensive exposure of the medulla. I have rarely seen a case here where simple incision into the periosteum or limited trephining of the metaphysis would suffice. I can only recollect two cases in the last five years. As already stated, the patients come from poor and remote districts where the services of a medical man are not readily obtained.

A review of the 11 successful cases treated by open drainage shows that convalescence is not at all smooth in a large proportion. A fluctuating temperature for some weeks occurred in 7 cases, in 2 it was associated with pyæmic abscesses. The charts show abundant evidence of the use of tonics and sera.

I have very little experience of the application of the Winnett Orr technique to acute infective osteomyelitis of other regions of the body. The method requires for its success a very good exposure of the infected area, with complete saucerization of the wound. It is easy to obtain such conditions in the tibia and perhaps the fibula and metatarsal bones. My colleague, Mr. MacDermott, has had very good results with the method in acute disease of the femur.

Seventeen cases would perhaps be considered a small number on which to base important conclusions; but all the patients had rather extensive disease of the medulla, and four were very severe infections. I think that a review of the cases proves that the method possesses the following advantages: (1) Economy of dressings; (2) Absence of pain, and ease in nursing; (3) The prevention of deformities; (4) A smooth convalescence with a lessening of the incidence of pyæmia. These are very solid advantages.

The one disadvantage is the smell. This is not at all bad with the first dressing. Good ventilation around the limb is the best way of avoiding it. There is in the hospital at present a patient who was admitted eight weeks ago with chronic osteomyelitis of the right tibia and left ulna. I treated both lesions by the Winnett Orr method. It has been necessary to renew the leg dressing once, but the upper limb dressing has given no trouble. I attribute this to the fact that the arm is kept outside the bedclothes and consequently gets good ventilation.

SHORT NOTES OF RARE OR OBSCURE CASES

LARGE CALCIFIED HYDATID CYST OF THE OMENTUM IMPACTED IN THE PELVIS AND CAUSING OBSTRUCTION OF AND HÆMORRHAGE INTO THE COLON.

By H. WALDEN FITZGERALD, Dunedin, N.Z.

The patient, a male of 70 years, was referred to me with the following history: Colicky pains in the abdomen, flatulence, constipation, 'tarry' and blood-stained stool, attacks of vomiting, and shortness of breath, for the last six months. The attacks of vomiting, colic, and constipation have become progressively and rapidly worse. There have been no urinary symptoms. The only incident in the previous history was, on the patient's story, a 'strained heart' thirty years ago while mountaineering, but at present his effort response is remarkably good.

Fig. 366.—X-ray appearance of the condition.

On Examination.—The respiratory and genito-urinary systems showed nothing of note. Cardio-vascular system: Few extrasystoles, blood-pressure 160/190, and otherwise fairly satisfactory. The central nervous system elicited no abnormality. Alimentary system: . The abdomen was distended and definitely rigid and tender in the hypogastrium. No peristalsis was observed. Per rectum the examining finger came immediately on to a large stony-hard immovable mass pressing directly on to the rectum from above and in front; the prostate was soft and uniformly slightly enlarged.

X-ray Examination (Dr. M. Barclay).—"Barium enema (July 26, 1932): The colon fills, revealing ballooning of the upper rectum, no tenderness, foreign body seen—(?) calcified mass. A large heavily calcified mass, measuring about

3 × 3½ in., lies centrally in the true pelvis, reaching from the pubic symphysis to the level of the pelvic brim. The barium enema was not obstructed, but the proximal portion of the rectum is narrowed, presumably owing to pressure. Findings are not suggestive of an intrinsic rectal lesion. It is impossible to see the lower sacrum and coccyx, which are overshadowed by the calcified mass. Elsewhere the bone is normal. Further investigation reveals the mass lying in the true pelvis, well in front of the anterior surface of the sacrum. The X-ray findings indicate that it is lying in the soft tissues between the rectum and the bladder." (*Fig.* 366.)

The Casoni Test (for hydatids).—Positive.

On Admission.—The patient was admitted to a nursing home on Aug. 4 after a severe collapse at his home following almost absolute constipation. He was very pale and his pulse rapid and rather poor. Repeated enemata gave huge results of 'tarry' and blood-stained, foul-smelling fæcal material. Following these, and the administration of large quantities of fluids, digitalis, and rest in bed his condition improved markedly and the abdominal distension subsided to some extent. On admission there was copious vomiting of almost fæculent vomit; this stopped following the repeated enemata.

Pre-operative Diagnosis.—(1) Calcified hydatid cyst of the omentum; (2) Dermoid cyst, calcified.

Operation (July 9).—Atropine and sodium amytal premedication. Ethyl chloride, and oxygen and ether anæsthesia. An attempt to catheterize the bladder failed owing to the mass pressing on the prostatic urethra. Medium Trendelenburg position. The abdomen was opened through a median suprapubic incision and the small gut packed off. The omentum was adherent in the pelvis to the bladder and parietal peritoneum; these adhesions were separated. The calcified cyst, almost entirely filling the pelvis, and grooved antero-inferiorly by the prostate, was delivered without much difficulty. It was found to be growing within the layers of the omentum; the omentum was clamped and the mass removed. The omental stump was ligated in bundles. The whole of the colon was filled and distended with hard fæcal masses. Rectum free from any growth and the stomach and duodenum normal. The cyst was not adherent at all in the pelvis, and had evidently grown in the omentum, possibly originating primarily from the liver, gravitating gradually to the pelvis, and there causing pressure symptoms. The abdomen was closed in layers without drainage. There was an uneventful convalescence except for a small abscess in the arm at the site of a hypodermic injection—this was opened and drained and healed without trouble.

Post-operative Diagnosis.—Calcified cyst of the omentum impacted in the pelvis causing pressure symptoms, the cyst being hydatid in origin.

Pathological Report (Otago University Pathology Department).—"The specimen consists of a calcified hydatid cyst 1½ × 3 × 3¼ in. with a well-marked groove on the anterior aspect where it had surrounded the prostate. The weight is 9 oz. The calcified wall is $\frac{1}{12}$ in. in thickness and the contents are portions of ectocyst apparently belonging to daughter cysts and a quantity of amorphous material in which scolices can be found."

Subsequent Progress.—There have been no untoward symptoms, and on examination at the end of January, 1933, everything was entirely satisfactory.

A CASE OF NEUROCYTOMA OF THE PELVIC SYMPATHETIC TRUNK.*

By A. W. FARMER and ERIC A. LINELL, Toronto.

This case is reported because of the rarity of the condition and the unusual interest of the microscopical findings.

The patient, a boy of 4½ years, came to hospital with the complaint of a sudden onset of urinary retention. Ribbon-like stools had been noticed for some weeks. The child was well nourished and did not appear acutely ill. Upon examination a hard mass was felt in the left lower quadrant of the abdomen, extending beyond the mid-line, and rising about an inch above the

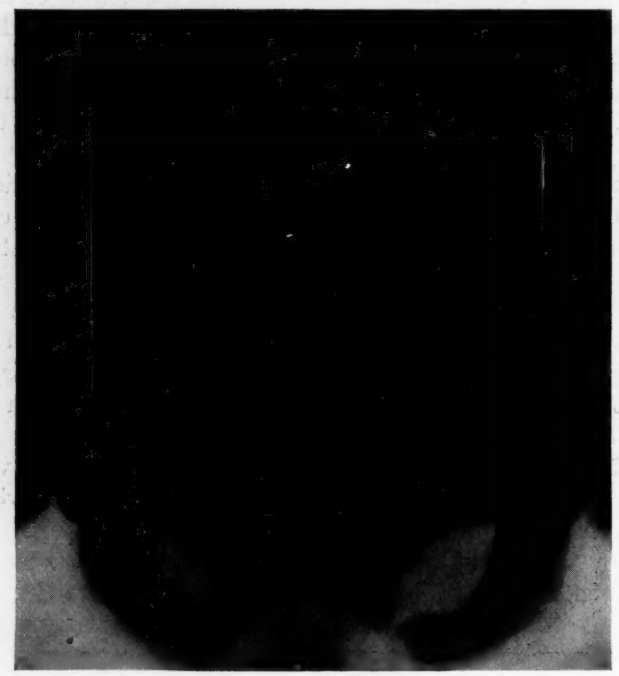


Fig. 367.—X-ray showing deformity and separation of segments of sacrum.

brim of the pelvis. The examining finger could be forced into the rectum with difficulty. The mass practically filled the pelvis and pushed the rectum forward and to the right side. The tumour was firm and smooth and was fixed to the sacrum.

An X-ray plate of the pelvis and sacrum showed considerable deformity and separation of the sacral segments (*Fig.* 367).

---

* From the Department of Surgery, Hospital for Sick Children, Toronto, and Division of Neuropathology, University of Toronto.

A biopsy was performed by excision of tissue from the posterior surface of the mass after removal of the coccyx. Later the tumour was excised in two stages. About one-third of the mass was removed through an abdominal incision and the remainder was resected four weeks later by an approach from below through the pelvic floor. The rectum was displaced forward against the symphysis pubis, the bladder being pushed up out of the pelvis. There was scarcely room for one finger to be inserted between the mass and the symphysis. The tumour was very easily separated from all surrounding structures except the sacrum, where it entered the anterior sacral foramina, and between the sacral segments.

The growth was considered to have invaded the foramina rather than to be growing out of them.

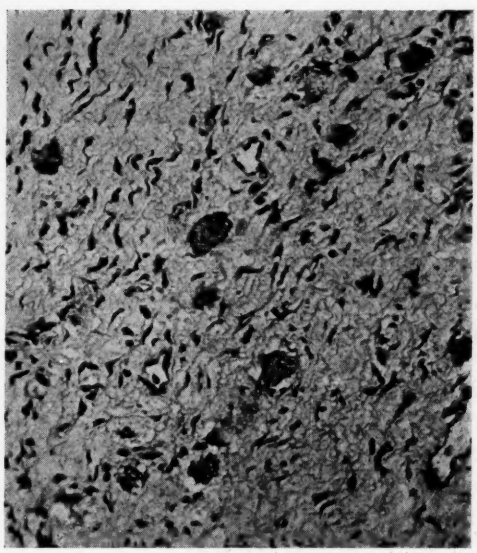


FIG. 368.—Low-power magnification of neurocytoma. Shows a number of multipolar nerve-cells lying in a stroma largely composed of fibroblasts. (Cresyl violet.)

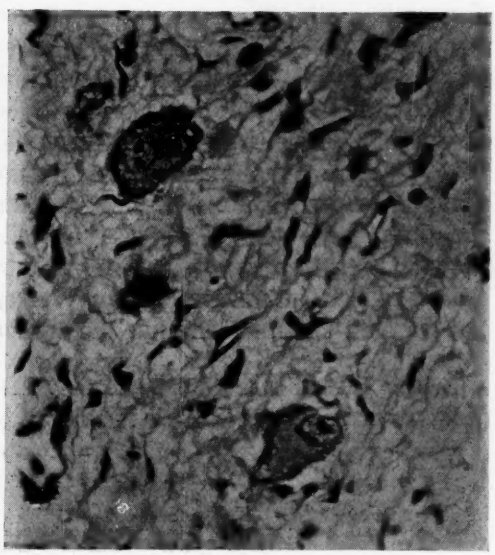


FIG. 369.—High-power microphotograph. Shows peripheral ring of Nissl granules in cytoplasm of nerve-cells. The fibroblast nuclei are somewhat irregular in shape and size. Neurilemmal sheath-cell nuclei are distinguished by their round or short-oval shape. (Cresyl violet.)

A retention catheter was inserted before operation. Following operation this was removed, but the bladder became distended almost to the umbilicus and then there was a constant overflow of urine. Neither before nor after the operation was any disturbance of perineal sensation noted. According to word received from the family physician two months after the discharge of the patient from hospital, the ability to empty the bladder voluntarily has not yet returned.

As it was impossible to be sure of the complete removal of the growth from between the sacral segments, the region was subjected to deep X-ray therapy.

The mass was not removed in one piece, so that an accurate measurement of its size was impossible. It was roughly oval in shape, being 4 in.

in its long diameter, and about 2½ in. in its short diameter. It was bluish-white in colour and uniformly firm in consistency. It showed in places nodular excrescences, which had a faintly yellow colour. On one surface of the tumour there was evidence that the growth had a thin fibrous capsule.

Microscopical Findings.—The tumour is composed mainly of fibrous tissue, scattered through which are bundles of non-medullated nerve-fibres and numbers of large multipolar nerve-cells. *Fig.* 368 shows a low-power microphotograph of the tumour tissue stained with cresyl violet. Under high magnification (*Fig.* 369) the large multipolar nerve-cells of the tumour are seen to have a ring of well-defined, peripherally-placed Nissl granules. The fibroblast nuclei are of a long oval shape, showing some irregularity in their contour. Processes can be seen arising from the poles of these nuclei. In this microphotograph can also be seen a few neurilemmal sheath-cell nuclei, distinguished by their round or short-oval shape.

Occasionally a nerve-cell can be seen undergoing division, and here and there are small collections of lymphocytes lying free in the tumour tissue. With Cajal's gold sublimate stain it is evident that there are large numbers of bundles of non-medullated nerve-fibres running through the tumour and that the main tumour mass is an intimate mixture of neoplastic non-medullated nerve-fibres and fibrous tissue. A silver impregnation picks out differentially the sheath-cell and fibroblast nuclei. With ammoniacal silver oxide the fibrous tissue bundles do not impregnate deeply, suggesting that the fibroblasts are somewhat immature. With Weigert's stain small medullated nerve-fibres can be seen running through the tumour in all directions.

Our thanks are due to Dr. I. H. Erb, Pathologist to the Hospital for Sick Children, Toronto, for his help.

CYST OF THE COMMON BILE-DUCT.

By D. G. DUFF,

SURGEON, DENBIGHSHIRE INFIRMARY.

Common-duct cyst is infrequent enough to warrant report of a case showing unusual features. Less than one hundred cases have been published, and it is stated by Wilson[1] that only three cases have been diagnosed before operation.

History.—In February, 1933, I saw with Dr. Leiper, Llanfair Talhaiarn, a multipara 62 years old who had been bed-ridden for over three months suffering from recurring bouts of abdominal pain with vomiting and constipation. Notes from her National Health Insurance record card show that, previously healthy, she was first incapacitated seven years before, when she had "gastritis". In August, 1928, and October, 1932, she again had trouble, and thereafter symptoms became steadily worse. Her doctor noticed an abdominal swelling and sent her to a hospital in November, 1932. "Pneumonia" supervened and she was kept in bed for three months, but on return home the swelling was again noticed.

On Examination.—I could find no more than an abdomen tender all over and peculiarly doughy to palpation, but on admission to Denbigh Infirmary a month later she had a large cystic immovable swelling in the upper abdomen as big as a football, and separate from the liver, which was pushed up about two inches. Bismuth enema showed a normal colon, and perabrodil injection gave a good picture showing normal renal pelvic anatomy and function. Other clinical tests revealed no abnormality, and a diagnosis of retroperitoneal cyst, possible cyst of the common bile-duct, was made.

Operation.—Operation disclosed an abdomen full of adhesions and with lymphatic channels throughout the peritoneal cavity full of grey-black pigment. A cystic swelling with tense grey walls occupied the position and had the relations of the lesser sac. The posterior wall of the stomach was so firmly bound down to its upper anterior surface that dissection was quite impossible. Aspiration gave dark bile under such tension that five pints were run off. The total contents were estimated to be eight pints. An opening was made and clots containing bile pigment and sediment were removed. A passage admitting the tip of the little finger was discovered flattened out in the posterior cyst wall and apparently leading to the ampulla of Vater. No other openings corresponding to the entrance of common bile, cystic, or hepatic ducts were found, but owing to the patient's condition little time was available for the search. It was impossible to explore the bile-passages outside the cyst, but by working through adhesions the gall-bladder and adjoining liver surface were exposed, both apparently perfectly normal. On the front wall of the cyst was a scar where, it was surmised, there had been a rupture some months before which had caused bleeding into the peritoneum and the adhesions mentioned. Hæmorrhage has been a frequent cause of death in these cases.

An anastomosis was made between the cyst and the highest available part of the gut, the jejunum 3 in. from its commencement. No clamps were used, and fine stitching was necessary owing to the vascular cyst wall. An opening to admit two fingers easily was made so that there would be free exit for any intestinal contents which might enter the cyst.

The patient made uninterruptedly good progress and is now very fit.

COMMENTARY.

Of interest is the unusual age of the patient, the average age at operation being 18,[1] and the fact that her symptoms developed so rapidly so late in life. The disappearance of the tumour made diagnosis at times quite impossible.

It may be noted incidentally that though infection in these cysts is frequent and biliary stasis necessarily present, true gall-stones have not been demonstrated either in the cyst or in the gall-bladder in any of the cases described. Swain, however, is said to have felt one at his cannula tip at aspiration.[2]

Difficulty has been found in explaining the formation of these so-called idiopathic cysts. The gall-bladder has been found normal in size in three-quarters of the cases,[2] while jaundice has been absent in at least eleven besides the present case. Saint,[3] after reviewing cases in regard to etiology,

rejects the theory of obstruction of the exit to the duodenum as a cause of their formation, on the ground that the biliary passages above may be, as in this case, normal in size.

The postulation of a valve action at the entrance to the cyst would overcome, I think, this objection. Quite often a crescentic fold of tissue has been observed obscuring the upper opening.[2] The existence of obstruction and usually[2] a valve mechanism at the exit is generally accepted. The gall-bladder will then act like a pump on the principle of the Bramah press so widely applied in hydraulic machinery. The tension of the cyst wall will be raised to such a point that at times the exit is straightened out and bile flows again into the duodenum. The effort required to effect this will constantly tend to increase, as in a hydronephrosis, and fibrous-tissue walls[2] will not withstand this. One can imagine that if once a minute round saccule develops in the wall of a collapsible duct, possibly from weakness in the muscular coat or from deformity due to the presence of a pancreatic rest or from failure of efficient fusion of fœtal elements, it will tend steadily to get bigger. It should be noted that the cyst found in a fœtus (Heiliger) was only 2·3 × 3 cm.—the smallest recorded—and therefore presumably at the beginning of its growth.

There is support for this theory of a double-valve action in the fact that when the pressure in the cyst is relieved by drainage these cysts rapidly shrink in size.[2, 3]

Stoney[4] found on re-opening the abdomen seven weeks after external drainage of a cyst of four-pints capacity that "there was now no evidence of a cyst or tumour in the abdomen and it was not possible even to recognize its collapsed wall". This shrinkage of the cyst helps to explain why a primary anastomosis of the cyst to the bowel has been so very much more successful than a preliminary external drainage followed by a secondary attempt at anastomosis, the results of which have been poor. It follows, too, that a large anastomotic opening is necessary. The cases where dilatation of the bile-passages above and cholangitis have occurred would be explained by a defective functioning of the valve at the cyst entrance.

CONCLUSIONS.

The operation of choice is the simple one of a primary anastomosis of cyst to gut, except where the cyst is so small and so free from adhesions as to be easily extirpated; even if there is infection of cyst contents the relief of pressure will help to prevent spread of infection to the liver. Anastomosis of the gall-bladder to the intestine would appear to be of little curative value, at any rate where the upper biliary channels are not dilated. If a simple external drainage is required by the very critical condition of the patient, the secondary anastomosis of cyst to bowel should not be delayed more than a week or two if possible.

REFERENCES.

[1] Wilson, *Jour. Amer. Med. Assoc.*, 1930, Aug. 9.
[2] Clark, *International Clinics*, 1932, i. (Bibliography.)
[3] Saint, *Brit. Med. Jour.*, 1932, i, 232.
[4] Stoney, *Irish Jour. Med. Sci.*, 1929, Dec.

A CASE OF GAS-CYSTS OF THE INTESTINE.

By F. C. PYBUS,

SURGEON, ROYAL VICTORIA INFIRMARY, NEWCASTLE-UPON-TYNE.

M. R. J., a female, 48 years of age, was admitted to the Royal Victoria Infirmary with pyloric obstruction. For fifteen years she had suffered from stomach trouble. For the first nine years the symptoms had been intermittent, there being short periods of freedom. During an attack there was pain half to one hour after food, the pain being epigastric and referred between the shoulders. It was relieved by food or alkalis. For the last few years the pain had been almost constant, unrelieved by food, had often been present at night, and each week she had a copious vomit. She had lost five stones in weight during the past eight years.

On Examination.—The patient was emaciated, and on abdominal inspection gastric peristalsis was obvious, but no further abnormality was detected. There was nothing unusual in the gastric analysis. X-ray examination showed calcified glands in the mesentery, extending through the mediastinum and almost the whole length of the neck. Twenty-four hours after a barium meal there was still a considerable residue in the stomach. Dr. S. W. Davidson noted that there was 'gas' between the liver and the right diaphragm, and the colon itself was full of gas. In view of the operative findings a re-examination of the radiogram shows the outlines of some of the cysts, though this is somewhat obscured by gas in the colon.

Operation.—Laparotomy was performed on Aug. 25, 1931. On opening the peritoneum it appeared at first sight as if there was a massive colloid carcinoma of the upper abdomen. Further inspection showed the condition to be due to gas cysts. The Registrar's description, taken at the time, fully describes the condition.

The falciform ligament of the liver, its adjacent peritoneum, and segments of the small intestine were the seat of numerous gas-containing cysts. The cysts were in bunches or clusters, looking like soap bubbles or like the cysts of a hydatid mole. They were transparent and collapsed with a 'pop' on puncture. Some of the cysts communicated with each other, others were isolated and varied in size from a pin-head to a cherry, but they were mainly in clusters. The clusters were distributed as follows :—

1. In the falciform ligament and the peritoneum on either side for about 2 in.

2. In the peritoneal coat of the small intestine, either singly or in grape-like masses, affecting the lower part of the jejunum and distributed as follows :—

1 ft. of affected bowel.
1 ft. of normal bowel.
About 6 in. of affected bowel.
1 ft. of normal bowel.
1 ft. of affected bowel.
A pedunculated grape-like mass with single stalk (*Fig.* 371).
1 ft. of normal bowel.
2 ft. of affected bowel.
3 in. of normal bowel.
1 ft. of affected bowel, followed by the remaining healthy intestine.

A photograph was obtained of the general mass (*Fig.* 370) and of an isolated segment of jejunum (*Fig.* 371). A portion of the cysts was removed for the museum, and for culture and microscopic examination. The stomach itself was grossly dilated and thick-walled, the pylorus stenosed and with an active ulcer beyond adherent to the pancreas. Gastrojejunostomy was performed, from which the patient made an uneventful recovery. In February, 1932, she appeared in perfect health, and had increased four stones in weight.

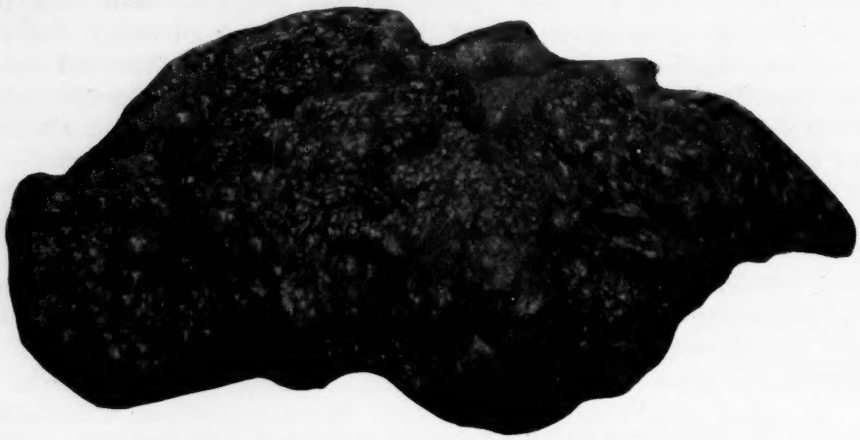


FIG. 370.—Coils of affected jejunum, showing gas cysts.

FIG. 371.—Segment of jejunum showing subserous cysts and a pedunculated portion.

PATHOLOGICAL REPORT (A. F. Bernard Shaw).—"The material consists of multiple round spaces lying in a loose connective tissue. The walls of the cavities appear to consist of the condensed surrounding tissue, and show no epithelial or serosal lining. In the connective tissue are many mobile histiocytes and some polymorphs."

On culture Dr. Slade reports that the cysts yielded a *Staphylococcus albus*, and a slender Gram-bacillus, with filamentous forms and characteristics of *Bacillus ramosus*.

RETROGRADE JEJUNOGASTRIC INTUSSUSCEPTION.

By JUDSON T. CHESTERMAN.

This condition is of sufficient interest to warrant record, not only on account of its rarity, but also because of the ease of diagnosis if its possibility is remembered, and the hopeless prognosis without early surgical intervention.

History.—W. T., male, aged 31, was admitted to the Beckett Hospital, Barnsley, on March 15, 1933, complaining of severe abdominal pain. He was perfectly well till 8 a.m. that morning, when he was "suddenly doubled up" with severe epigastric colic while dressing. This was not relieved by alkaline powder, brandy, or turpentine stupes. At 9 a.m. he vomited a "teacupful" of bloody fluid and again at 10.30 about "a pint" of blood-stained fluid, but he obtained no relief. At 11.15 he was admitted to hospital and treated expectantly as "a medical colic". At 8.30 p.m. I was asked to see the patient, who had been in continuous unrelieved pain since admission. He stated that in 1926 he had been operated upon for "gastric ulcers", but the nature of the operation was unknown. He had had no symptoms of any abdominal disorder since.

On Examination.—The patient lay doubled up on his left side; his face was ashen grey and he was perspiring freely. Pulse 64, temperature 98°, respirations 20.

On inspection the abdomen showed marked erythema due to the stupes; there was an old right supra-umbilical paramedian scar, and the whole outline of the stomach was clearly visible from the bottom of the bed. No rigidity was present on palpation, but the stomach outline was extremely tender. The stomach area was dull on percussion. Occasional sounds were noted in the right iliac fossa on auscultation. Rectal examination showed nothing abnormal. Atropine $\frac{1}{30}$ gr. was ordered to relieve the pain and facilitate examination.

At 8.50 p.m. there was a copious bloody vomit and at 9.15 p.m. the patient was re-examined. The stomach outline was not apparent, but was replaced by a round tumour in the left hypochondriac region, which was extremely tender, though the belly was soft elsewhere and palpation caused no discomfort.

The diagnosis of jejunogastric intussusception was made for the following reasons: (1) Sudden onset of severe epigastric colic; (2) Repeated bloody vomit; (3) Complete absence of rigidity and tenderness only over tumour.

Operation.—The abdomen was immediately opened by a left paramedian incision. Posterior no-loop iso-peristaltic gastrojejunostomy was found, with retrograde intussusception of 2 ft. of jejunum into the stomach through the stoma. Reduction after opening lesser sac. No cause found. The mesentery of the small gut was sutured to the transverse mesocolon near the jejunal border in two places to prevent recurrence.

Subsequent Progress.—The patient was discharged on May 1 after an uneventful convalescence. On Aug. 4 he was at work and absolutely fit.

RECURRENCE OF GASTRIC CARCINOMA TWELVE YEARS AFTER PARTIAL GASTRECTOMY.

By A. B. PAIN,

LATE SURGICAL TUTOR, UNIVERSITY OF LEEDS, AND SURGICAL REGISTRAR, GENERAL INFIRMARY AT LEEDS.

This case is of interest on account of the long interval which elapsed between the original operation and the appearance of the recurrence. An interval of twelve years, however, is by no means the longest on record: Shuman[1] recorded a case in which recurrence occurred seventeen years after partial gastrectomy, and Pearce Gould[2] recorded one in which recurrence took place eighteen years after partial gastrectomy, although he considered that in this case the history suggested that what was described as a recurrence was probably an entirely new growth. Peugniez[3] reported a case in which there was clinical evidence of recurrence, probably in the stomach, twenty-four years after partial gastrectomy, although this suspicion was not confirmed by post-mortem or histological examination. Persson,[4] in a series of 262 cases of carcinoma of the stomach submitted to partial gastrectomy, reported 9 cases which died of recurrence more than six years after operation, the longest interval being seventeen years.

Hartmann[5] stated that recurrence of carcinoma more than two years after partial gastrectomy is exceptional, and, further, that almost all recurrences are lymphatic and peritoneal, recurrences in the gastric mucosa being very rare; he could only record 1 such case in 46 cases of proved recurrence. In a further report[6] he recorded a series of 80 cases of gastric carcinoma which died with recurrences, all within four years of operation.

The history of the present case is as follows:—

The patient, a man of 40 years of age, was admitted to the General Infirmary at Leeds under the care of Mr. J. F. Dobson on July 5, 1919, with a six months' history typical of carcinoma of the stomach. There was a palpable tumour in the epigastrium to the right of the middle line; X-ray examination showed almost complete retention six hours after the ingestion of an opaque meal, with great dilatation of the stomach and almost complete absence of peristalsis; no filling defect was seen.

At operation, performed by Mr. Dobson on July 21, the stomach was found to be considerably dilated, with a large mass having the naked-eye characteristics of carcinoma occupying its pyloric half. Partial gastrectomy was performed, three-quarters of the stomach being removed, together with enlarged lymph-nodes along both curvatures; the jejunum was united to the stump of the stomach by an end-to-side retrocolic anastomosis. The man was discharged from hospital on Aug. 8, 1919.

No histological examination of the resected portion of the stomach was made, but Professor M. J. Stewart reported that the growth was a large soft carcinoma of the pyloric region.

The patient was re-admitted to the General Infirmary at Leeds on March 19, 1928, complaining that for four months previously he had suffered from epigastric pain coming on soon after meals, and that he had lost much

weight; he had also found that he had to take very small meals. Fractional test-meal examination showed that there was no free hydrochloric acid in the gastric juice, and that bile was present in all specimens. X-ray examination after an opaque meal showed no evidence of carcinoma in the remaining portion of the stomach, which emptied rapidly.

The patient was discharged on March 30, and from that time until May, 1930, was quite well. He then began to have pain and fullness after meals, and in September, 1930, he noticed a sense of obstruction to swallowing at the level of the lower end of the body of the sternum; he commenced to vomit after meals and rapidly lost weight.

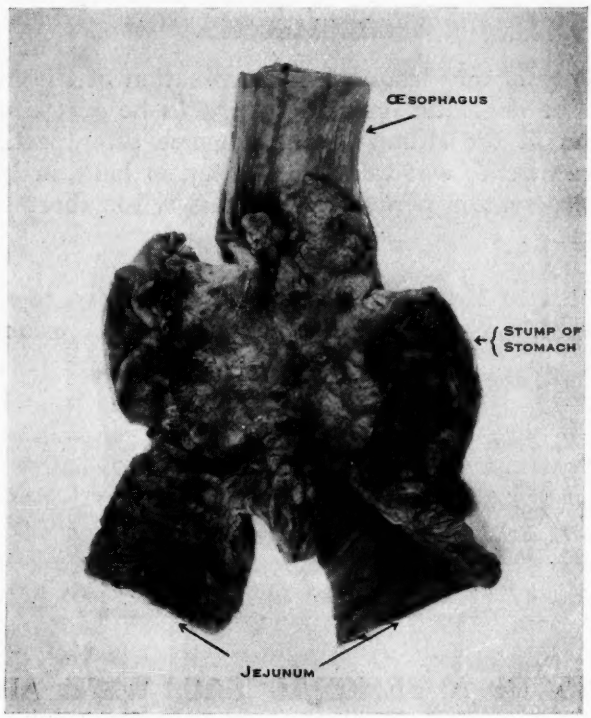


FIG. 372.—Condition found at autopsy.

He was re-admitted to the General Infirmary at Leeds on May 11, 1931, and again came under the care of Mr. Dobson. X-ray examination after an opaque meal demonstrated the presence of an obstruction at the cardiac orifice, with much dilatation of the œsophagus; the stump of the stomach could not be filled with bismuth for examination.

On May 26, under local anæsthesia, jejunostomy by Witzel's method was performed, using the efferent jejunal loop (A. B. P.). Death occurred four hours after operation.

POST-MORTEM EXAMINATION (Professor M. J. Stewart).—The small portion of the stomach (*Fig.* 372) which had been left behind was almost entirely converted into a large ulcerated carcinoma, situated saddle-wise across the upper part of the lesser curvature, completely encircling the gastro-jejunal

anastomosis, and extending at one point fully an inch up into the œsophagus. Only the region of the greater curvature in the middle of the remaining portion of the stomach had escaped. The tumour had a soft raised overhanging margin with various polypoidal projections, especially upwards into the œsophagus. Several glands heavily invaded by carcinoma lay in relation to the tumour; the growth wass lightly adherent to the spleen at the upper end of the hilum, where it had penetrated the wall of the stomach. The pancreas was also slightly invaded, and there were two secondary nodules in the liver.

Histologically, the tumour was a fairly well differentiated adenocarcinoma, which had penetrated deeply into the muscularis mucosæ.

CONCLUSIONS.

In the absence of any histological examination of the first specimen, it is impossible to be dogmatic, but this seems to be a case of recurrence of gastric carcinoma in the stump of the stomach after partial gastrectomy. The fact that recurrence can take place after so long an interval suggests that the usual observation period of ten years is too short to be conclusive in assessing cures.

I am indebted to Mr. J. F. Dobson for permission to record this case, and to Professor M. J. Stewart for his help and for the use of the records of his department.

REFERENCES.

[1] SHUMAN, J. W., *Jour. Amer. Med. Assoc.*, 1926, lxxxvi, 1127.
[2] GOULD, E. PEARCE, *Brit. Jour. Surg.*, 1927, xv, 325.
[3] PEUGNIEZ, P., *Bull. de l'Acad. de Méd.*, 1924, xci, 831.
[4] PERSSON, M., *Ann. of Surg.*, lxxxvi, 321.
[5] HARTMANN, H., *Bull. de l'Acad. de Méd.*, 1926, xcv, 44.
[6] HARTMANN, H., *Ibid.*, 1932, cvii, 95.

APPENDICITIS IN A FEMORAL SAC, WITH ADVENTITIOUS VASCULARIZATION OF A SEGREGATED APPENDIX.

BY A. S. JOHNSTONE,
LATE SENIOR HOUSE SURGEON, LEICESTER ROYAL INFIRMARY.

DISJUNCTION of an appendix from localized destruction of the whole thickness of the organ is by no means uncommon, the vitality of the distal portion being ensured by the integrity of that portion of the meso-appendix. In the following case the solution of continuity was shared alike by the appendix and its mesentery.

HISTORY.—A moderately well nourished, healthy multipara, aged 67, was admitted to hospital complaining of a swelling in the right groin of seven weeks' duration. Except for enteric fever some forty years previously, she had had no important illness, no previous attack of appendicitis, and was not aware of the existence of a femoral hernia.

Three months previously she had severe colicky pains about the umbilicus. She had no vomiting and passed a restless night. On the following day, though the general malaise continued and was associated with anorexia, she had a normal evacuation of the bowels and was able to carry out her daily household work. A week later discomfort in the right groin called her attention to a swelling which appeared inflammatory, and after repeated fomentation an abscess opened through the skin and discharged a large quantity of foul-smelling pus. Thereafter, the swelling having subsided, the abscess quickly healed. A month later a painless swelling reappeared at the site of the abscess, and as it gave some inconvenience in walking operation was decided on.

On Examination.—The contour of the abdomen was normal, there was neither hyperæsthesia nor tenderness, and no muscular rigidity. In the right femoral triangle lateral to the pubic spine was a lobulated cystic swelling some 35 mm. in diameter, apparently fixed to the deep fascia at the femoral ring, though free from the skin, which over it was of a slightly bluish tint. There was no impulse on coughing, and the cysts could not be emptied by digital pressure. There were no enlargements of adjacent lymph-nodes, no varicose veins, and no cutaneous source of lymph-vascular infection.

Operation.—Under general anæsthesia, after longitudinal incision, the skin was reflected bilaterally. Some cysts opened during the delimiting dissection allowed the escape of a mucinous material, and beyond the cystic area was exposed the wall of a sac which could be traced to the femoral ring. Very dense adhesions were present, and considerable difficulty was experienced in separating the sac from the femoral vessels.

After isolation the sac was opened and the appendix was found attached to its anterior surface, the base of the appendix towards the neck of the sac, to which parts the mucoid cysts were closely related. A strand of great omentum attached to the appendix was divided, but the cæcum could not be felt by the finger passed through the femoral canal. The sac and appendix were then removed and the canal closed.

Macroscopic Findings.—Inspection of the portions removed showed a multilocular cystic mass close to the base of the appendix with the lumen of which it communicated through a small perforation. Lying within the lumen of the appendix at this point were two small chips of china, probably of etiological importance as regards the mucinous cysts. It was evident that the appendix had an adequate blood-supply through its adventitious adhesion to the wall of the sac.

COMMENTARY.

The interest of this case lies in the occurrence of an auto-appendicectomy and the continued viability of the appendix after the acquisition of a new blood-supply. It may be surmised that there was a pre-existing femoral sac in which the appendix had come to lie at some earlier period, and, after adhering to the wall, had acquired a new blood-supply. It is unlikely that this could have occurred during suppuration, when considerable thrombosis and phlebitis in the meso-appendix would be present. The lumen of the

appendix was found obliterated and entirely fibrous at its proximal end, where lay the two foreign bodies. An acute attack of obstructive appendicitis occurred, passed to abscess formation with gangrene at the constricted area, and finally caused complete severance of the appendix. It seems unlikely that the appendix was detached prior to the attack, as the foul-smelling pus indicated that fæcal infection had been present. A small strand of omentum was all that remained as a barrier between the infected area and the abdominal cavity. After resolution of the abscess the appendix returned to a fairly normal condition in its new surroundings, its blood-supply being adequate. A small perforation existed in the wall adjacent to the foreign bodies whose presence excited a continued secretion of mucus, which, finding its way into the surrounding tissues of the sac wall, led to the formation of multilocular cysts.

Perusal of the literature of femoral appendicitis fails to discover a similar occurrence. A number of cases of acute appendicitis in a femoral hernial sac are described and cases of resolution are recorded, but the occurrence of auto-appendicectomy and the survival of the separated part of the appendix appears unique.

I am indebted to Mr. Bolton Carter, of Leicester, for permission to publish this case, and to Mr. D. M. Greig for his assistance in preparing it.

REVIEWS AND NOTICES OF BOOKS.

Rose and Carless' Manual of Surgery. By CECIL P. G. WAKELEY, D.Sc. (Lond.), F.R.C.S. (Eng.), F.R.S. (Edin.), Surgeon, King's College Hospital, etc.; and JOHN B. HUNTER, *M.C.*, M.Chir. (Cantab.), F.R.C.S. (Eng.), Surgeon, King's College Hospital, etc. Fourteenth edition. Large 8vo. Pp. 1487 + viii, with 721 illustrations and 24 plates (16 coloured). 1933. London: Baillière, Tindall & Cox. 30s. net.

IT is only three years since the appearance of the last edition of this work, which has now become the students' and practitioners' classic. It is a testimony both to the diligence of the editors and to the progress of surgery that so much addition and alteration have had to be made in the present issue. Hitherto an attempt has been made to keep the work to the size of a 'handbook', but now, although this single-book edition is presented and the total number of pages not increased, yet the alternative of a double volume is offered at the same price.

As regards general get-up, there has been a marked advance. The paper is of a superior quality and surface, so that the reproduction of the figures leaves nothing to be desired. Of the illustrations no fewer than 300 out of a total of 744 are new, and about half the plates are either new or redrawn. In the selection of additional figures, the editor has very wisely been guided by the main consideration of clearness and instructive character. Thus line drawings and diagrams have been put in rather than photographs. These three points—the new paper, the new figures, and the large number of line drawings—in themselves constitute a notable advance. The X-ray plates are now interspersed where wanted in the text instead of being placed all together at the end of the book.

Among the sections which have been largely revised or re-written are the following: the treatment of malignant disease by radium; the surgery of the sympathetic nervous system; thoracic surgery; and the treatment of fractures according to Böhler's technique.

A work of this size and importance requires the co-operation of several specialists. Not only has Mr. Wakeley been joined by Mr. Hunter as co-editor, but he has had the assistance of Carnegie Dickson (pathology), V. E. Negus (ear, throat, and nose), Bishop Harman (ophthalmology), Eardley Holland (gynæcology), Sir Frank Connor (military surgery), and C. F. Hadfield (anæsthesia).

It is a very happy thing that the original work of two great King's College surgeons should be carried on by two of the King's men of to-day, and that in building up this great work on surgery they should be perpetuating the memory and work of the greatest of British surgeons, Lord Lister of King's. We congratulate the editors and publishers on a notable success.

Demonstrations of Physical Signs in Clinical Surgery. By HAMILTON BAILEY, F.R.C.S., Surgeon, Royal Northern Hospital, etc. Fourth edition, revised and enlarged. Large 8vo. Pp. 287 + xx, with 335 illustrations, some of which are in colour. 1933. Bristol: John Wright & Sons Ltd. 21s. net.

THIS is a new and improved edition of what has now become a very well-known text-book. A strong point of this work has always been the number and excellence of the illustrations, and in this particular the present edition excels.

Some of the illustrations are works of art, and, as was once said about Howard Kelly's extravagantly illustrated work an appendicitis, "any one of them might be

framed and hung up to decorate the office". Pictures in colour are sometimes misleading, but the figure illustrating rupture of the urethra is very realistic indeed. Many of the simpler diagrams are very telling, especially those that have been made in elucidation of actual cases; they supply excellent models for anybody interested in the keeping of simple yet graphic case records.

Of course, there are a few things which strike the reviewer and suggest mild criticism, but they are not really very important. For instance, for testing surface temperature, the illustration suggests that the tips of the fingers are sufficient, whereas one has always recognized that it is much wiser to use the palm of the hand. But the book is indispensable and there can be nothing but praise for the continued efforts of the author and his publishers, not only to keep it up to date, but to improve it.

The Practice of Surgery. By RUSSELL HOWARD, C.B.E., M.S. (Lond.), F.R.C.S., Surgeon, London Hospital, etc.; and ALAN PERRY, M.S. (Lond.), F.R.C.S., Surgeon, London Hospital, etc. Fourth edition. Medium 8vo. Pp. 1338 + viii, with 584 illustrations and 8 coloured plates. 1933. London: Edward Arnold & Co. 30s. net.

THE new edition of this well-known book maintains the characters which made former editions so popular. Its merits are many. In the first place it is a student's text-book and has remained so. The authors have selected with much discrimination what is really necessary to teach the undergraduate. In the second place, having made up their minds on this supremely important question, they have stated simply, directly, and sometimes dogmatically what should or should not be done under any given circumstances. This is what the student requires when such debatable subjects as the operative treatment of exophthalmic goitre or chronic mastitis are in question. Taken as a whole the recommendations are those usually accepted by surgeons of experience.

The are a few—very few—omissions, such as the treatment of Raynaud's disease by sympathetic ganglionectomy, and a few incorrect statements, such as that which leads the reader to believe that temporary recovery only has followed Trendelenburg's embolectomy. Also we read the trans-sacral removal of the rectum has been almost entirely abandoned, whereas there has of late been increased interest in this operation both in England and abroad.

Gastrojejunostomy for hæmorrhage from a gastric ulcer recommended on page 715 is worse than useless, as it exhausts the patient and does not stop the bleeding. There are better things to do not mentioned in this text-book. It is also not quite correct to say that Continental surgeons recommend partial gastrectomy for duodenal ulcers. Some surgeons, both in this country and abroad, recommend partial gastroduodenectomy.

We doubt if Phelps' operation for talipes is often carried out nowadays, and the suggestion that Marsh's knee truss for internal derangement keeps the semilunar cartilage in place is not in conformity with pathology. However, there is very little to cavil at in this text-book. There is rather a clumsy sentence on page 299 and another on page 1265. The printing and illustrations are excellent. The work bears the imprint of a great teacher: its simple, direct, and well-balanced statements render it pre-eminently suitable for the undergraduate student, by large numbers of whom it will doubtless be read.

Operative Surgery. By WARREN STONE BICKHAM, M.D. and Phar. M. (Tulane), M.D. (Columbia), F.A.C.S., Former Surgeon in charge of General Surgery, Manhattan State Hospital, New York, etc.; and CALVIN MASON SMYTH, jun., B.S., M.D., F.A.C.S., Assistant Professor of Surgery, Graduate School of Medicine, University of Pennsylvania, etc. Vol. VII, The Newest Operations and General Index. Royal 8vo. Pp. 849 + viii, with 765 illustrations. 1933. Philadelphia and London: W. B. Saunders Co. 55s. net.

THIS is a seventh and supplementary volume to the original work in six volumes published in 1924. Since that time many additions have been made to the operations which surgeons may be called upon to perform, and this volume has become

necessary. It is divided into sections, each of which modifies and brings up to date a section in the complete work. There is an extremely well-thought-out introduction concerning the art and craft of surgery at the present time. It is followed by sections dealing with pre- and post-operative treatment, with sterilization, with anæsthesia, in which basal and local anæsthesia are most fully considered, and with electrosurgery.

In the sections dealing with the chest and colon the most numerous additions are to be found. The chest section in particular is especially full, which is to be expected when we remember that until recently this was practically a virgin field. More might have been made of the surgery of the sympathetic nervous system. The description of cervical sympathectomy is vague and incomplete, and removal of the inferior mesenteric ganglion in the abdomen is not mentioned at all. It may be that this branch of surgery is not so popular in America as it is in this country.

In places the originators of new operations are not given, but the author apologizes for this. An occasional lapse in this direction is hardly to be avoided when almost all the precedures are taken from descriptions in current medical literature.

The illustrations are numerous and clear, and they show most of the operations step by step. The text is clear and easily readable. The addition of this volume certainly makes it the most complete and up-to-date work on operative surgery in the English language.

The Art of Surgery: A Text-book for Students and Practitioners. By H. S. Souttar, D.M., M.Ch. (Oxon.), F.R.C.S., Hon. M.D. Trinity College, Dublin, Surgeon, London Hospital. Second edition. Large 8vo. Pp. 630 + x. Illustrated. 1933. London: William Heinemann (Medical Books) Ltd. 30s. net.

The first edition of this work appeared in 1928. We are assured in the seven-line preface to the second edition that "the greatest care has been taken to include all that is valuable in recent methods", but we confess that we have been rather disappointed in the fulfilment of this promise. For example, neither the sympathetic nervous system nor Raynaud's disease is mentioned in the index, nor is any reference to sympathectomy made in the article on Hirschsprung's disease.

The book certainly has a charm of its own, in its differences from other textbooks. Its wide margins, in which appear the many little 'thumb-nail' sketches, present an invitation to the student to add notes of his own with further drawings. Many of the coloured figures, although undoubtedly works of art, do not convey a clear idea of the thing presented.

In pointing out some of the defects of this book, we do not wish to do anything but improve it. There is a great charm in its get-up, in its diction, and its well-balanced choice of what to put in and what to leave out.

Recent Progress in Medicine and Surgery, 1919-1933. Edited by Sir John Collie, C.M.G., M.D., D.L., J.P. With a Foreword by Lord Horder of Ashford, K.C.V.O., M.D., F.R.C.P. Demy 8vo. Pp. 368 + xii, with 34 illustrations. 1933. London: H. K. Lewis & Co. Ltd. 16s. net.

It is useful to take stock of one's knowledge from time to time, and this is especially the case with medicine and surgery, where progress just now is extraordinarily rapid. New discoveries and new inventions have led to a new nomenclature and the use of terms which the older members of the profession can only understand by their etymology—and not always then The modern school often uses words which seem to be composed of corrupt Greek and mediæval Latin. Sir John Collie has enlisted the services of an excellent team of writers to deal with recent progress in medicine and surgery, and has himself contributed an article on active immunization against diphtheria, a subject in which he has interested himself as Chairman

of the Public Health Committee of the Paddington Borough Council. Mr. H. A. T. Fairbank, D.S.O., Senior Orthopædic Surgeon to King's College Hospital, writes on orthopædic surgery and its modern development as a result of experience in the European War. Mr. J. Swift Joly, who is Senior Surgeon to St. Peter's Hospital, describes, in his article on urology, the great advances which have been rendered possible by the use of X rays and the revolution in the treatment of the prostate which has taken place within the last twenty years. The conservative treatment of surgical tuberculosis has been entrusted to the capable pen of Sir Henry Gauvain, and that on plastic surgery to Sir Harold Gillies, who has made the subject his own. The articles on manipulative surgery are written by Dr. J. B. Mennell, who proves that there are better 'bonesetters' within the profession than amongst those who work without a registrable qualification; whilst Mr. I. W. Magill tells of the very great changes which have occurred in the production of anæsthesia since the time when chloroform was administered on a towel or a square of lint. The advances in medicine have been placed in equally capable hands, and amongst the special departments there are articles on the eye, oto-rhino-laryngology, and bacteriology, written respectively by Sir William S. Duke-Elder, Sir James Dundas-Grant, K.B.E., and Dr. R. Tanner Hewlett. Professor J. M. Woodburn Morison has a well-illustrated article on radiology which is thoroughly practical.

Surgical Anatomy. By C. Latimer Callander, A.B., M.D., F.A.C.S., Assistant Clinical Professor of Surgery and Topographic Anatomy, University of California Medical School. With a Foreword by Dean Lewis, M.D., Sc.D., LL.D., F.A.C.S. Super royal 8vo. Pp. 1115, with 1280 illustrations, some in colour. London and Philadelphia: W. B. Saunders Co. 63s. net.

This is not merely a treatise on surgical anatomy; in fact, in places descriptive anatomy is dealt with less thoroughly than its application. Many operations—and these not always the most important in surgery—are dealt with at length; other operations are briefly touched upon with no particular attempt to emphasize their relation to the anatomy of the region then under discussion. But, as suggested, the book contains a great deal more than its title would indicate. There are in places full accounts of the signs and symptoms of different surgical diseases and injuries, and, last but by no means least, it is profusely and beautifully illustrated. The figures themselves more than justify the book. They are on the whole well chosen, and as the keynote throughout is operative surgery they demonstrate the relation of anatomy to the operation under discussion.

The book is written in a diffuse, digressive manner, rather typical of American productions, and for this reason it is not likely that the letterpress will make a strong appeal to British surgeons; but there is no volume of surgical anatomy in this country which has anything like the illustrations which are to be found over the name of Ralph Sweet and others. As is usual in the case of work coming from the Saunders Company, the general output of the volume is first rate, though perhaps one might take exception to one minor point—the extreme weight of the volume.

A Short History of Surgery. By Sir D'Arcy Power, K.B.E., F.R.C.S., Hon. Librarian of the Royal College of Surgeons of England. Crown 8vo. 1933. London: John Bale, Sons & Danielsson, Ltd. 3s. 6d. net.

This is a delightful little book which gives in its eighty odd pages a good account of the subject with which it deals. It will doubtless become the regular primer of the history of the healing art, for it is written in the easy style which we associate with Sir D'Arcy Power and it is all made so interesting that there will be few who put the book down before completing its pages.

The headings of the chapters give a good indication of the way the author deals with his task. Those on Specialism, American Surgery, and Surgical Nursing indicate the wide scope of this work. The author has a good word to say for what

we now look upon as the very out-of-date type of nurse, and instances the famous Mrs. Porter—but she was surely the light of her calling in the Royal Infirmary in Edinburgh, and not in charge of Lister's operation ward in Glasgow as stated. These wonderful women may have been ill-educated and a little uncouth, but as one who is able to judge (G. H. Edington) has written, " they knew how to nurse and they did it ".

Another little error has crept into the chapter on Modern Surgery, in which the author deals so succinctly with the development of the treatment of wounds, for he states that the crude carbolic which was brought to the notice of Lister by Thomas Anderson, Professor of Chemistry in Glasgow, had been used to prevent decomposition in the refuse heaps of that city. As a loyal Englishman one has always thought that it was its remarkably beneficial effect on the sewage of Carlisle that really gave the inspiration to the use of carbolic acid!

The chapter on Specialism is wonderfully complete, including as it does a paragraph on dentistry. Despite the shortness of the chapter devoted to American Surgery, it is rather sad to find no mention of McDowell and his pioneer ovariotomy.

Every student should have the opportunity of reading this little book, and it would not be a bad thing to make its perusal introductory to the study of surgery.

The book is of handy form and well printed on good paper, and is provided with a useful index.

Papers Relating to the Pituitary Body, Hypothalamus, and Parasympathetic Nervous System. By HARVEY CUSHING, Professor of Surgery (Emeritus), Harvard University, etc. Large 8vo. Pp. 234 + viii, with 99 illustrations. 1933. London: Baillière, Tindall & Cox. 29s. net.

FOUR lectures delivered by Professor Harvey Cushing during the past three years, all dealing with the physiology and pathology of the interpeduncular region of the brain, and previously scattered in different medical journals, are now happily collected together in this volume. Two are concerned primarily with the pituitary body, and two with the hypothalamus as a cerebral centre of the parasympathetic system. The pituitary lectures are clearly the fruit of many years of study and experience; the others, though equally absorbing and stimulating, are more conjectural.

In the Lister Memorial Lecture on " Neurohypophysial Mechanisms from a Clinical Standpoint ", Professor Cushing presents a masterly review of the experimental and clinical evidence of the interdependence of the anterior lobe of the pituitary body, the infundibular lobe with its epithelial investment, and the diencephalon. The lecture reads almost like the report of the proceedings in a court of law, the author adopting successively the rôles of witness, counsel, and judge. It is left to the reader as a member of the jury to decide whether the mechanisms which govern metabolism, the water balance of the body, the functions of sex, and even the perpetuation of the species, reside primarily in the pituitary body or in the interbrain.

The lecture on " The Basophil Adenomas of the Pituitary Body " describes the steps which led to the discovery that patients showing a peculiar form of adiposity, associated with kyphosis, sexual dystrophy, hypertrichosis, high blood-pressure, erythræmia, and weakness—a clinical picture which has already been named 'Cushing's syndrome'—have basophilic adenomas. The clinical and pathological findings are correlated in 16 cases, some observed personally and the remainder reported by others. The picture resembles that produced by some adrenal tumours, and even when a basophilic adenoma has been found in the pituitary body, changes in the other ductless glands have been present also. It is argued, however, that the pituitary lesion is the primary one, the changes in the other endocrine organs being secondary.

The very remarkable experiments recorded in the lecture on " The Posterior Pituitary Hormone and the Parasympathetic Apparatus " were originally intended merely to establish the existence of a posterior-lobe hormone. As a result of the

experiments, however, the fact emerges that the effect of injecting pituitrin intramuscularly or intravenously is entirely different from the effect produced by intraventricular injection. Whereas the former resembles the reactions of sympathetic stimulation, intraventricular injection produces a reaction which is predominantly parasympathetic, resembling closely the response to intraventricular pilocarpine, being counteracted by atropine, and not occurring when there is internal hydrocephalus or disease of the hypothalamus. It is therefore suggested that pituitrin stimulates parasympathetic centres in the hypothalamus. The lecture deserves careful study and will provide much food for thought. Some of the reactions described appear to be a peculiar mixture of sympathetic and parasympathetic responses, and it may be that stimulation of the hypothalamus, if this is indeed what occurs, gives rise to phenomena which are neither purely parasympathetic nor sympathetic in nature.

This difficulty in the interpretation of the evidence recurs in the last lecture on "Peptic Ulcer and the Interbrain". Records are quoted of cases in which ulceration of the stomach and duodenum has occurred in association with lesions of the brain, and it is suggested that the ulcers may be caused by hyperacidity and localized vascular disturbances in the stomach resulting from stimulation of parasympathetic centres in the hypothalamus. In the majority of the cases the cerebral lesion was neoplastic, but Professor Cushing goes so far as to hint that the centres in the interbrain might be affected by psychic influences, the result being a chronic gastric or duodenal ulcer. It is a fascinating theory, and it is most stimulating to meet an Emeritus Professor with the imagination of perpetual youth! We are left in doubt why psychic stimuli should evoke from the hypothalamus sometimes sympathetic and sometimes parasympathetic responses, but we hope that further investigations along the lines indicated in the lecture may provide the solution of this intricate problem.

The lectures are profusely and clearly illustrated, and enough has been said to indicate that they may be read and re-read with much profit.

History of Urology. Prepared under the auspices of the American Urological Association. Editorial Committee: E. G. Ballenger, W. A. Frontz, H. G. Hamer, B. Lewis. Two volumes. Royal 8vo. Vol. I. Pp. 386 + xii, with 46 illustrations. Vol. II. Pp. 362 + vii, with 12 illustrations. 1933. London: Baillière, Tindall & Cox. 36s. net.

This is a useful and comprehensive history of one of the later specialties of surgery. It is more valuable because very full references are made to each of the subjects with which it deals. The book has been prepared under the auspices of the American Urological Association by a small editorial committee with Dr. Bransford Lewis as Secretary. Each volume contains fifteen chapters by various writers of repute in their own subjects, the articles ranging from surgical diseases of the kidney to affections of the scrotum, testes, and seminal vesicles. There are also chapters on the anatomy and physiology of the genito-urinary organs, anæsthesia, diagnosis, bacteriology, and the neuroses and functional disorders of the genito-urinary tract. All are of great practical value to surgeons practising genito-urinary surgery, and where all are so good it is perhaps invidious to draw attention to the particular excellence of the chapters on prostatic surgery. The first eight chapters of the first volume deal with the early history of urology in the different cities and states of the Union. They are good reading because they are full of details showing the varying social conditions under which medical practitioners lived even as lately as 1900: men of the highest culture in cities like New York, Philadelphia, Boston, and Baltimore; others practising in outlying parts who had received no medical education and were under conditions not far removed from those pictured by Bret Harte, who owed their very existence to their ability to shoot at sight. Yet both classes did good work in urology, and from their pioneer labours came the American Urological Association, "born of poor but honest parentage in a humble wine house of New York on Washington's Birthday, February 22nd, 1902". Even if the book had no other value, it would be well worth reading for its pictures of a time which is now beyond recall, though it is so near that the authors write from personal knowledge of the great originals whose stories they tell.

The Physician as a Man of Letters, Science, and Action. By THOMAS KIRKPATRICK MONRO, M.A., M.D., Regius Professor of Medicine in the University of Glasgow. Demy 8vo. Pp. 212 + viii. 1933. Glasgow: Jackson, Wylie & Co. 10s. 6d net.

DR. MONRO, the Regius Professor in the University of Glasgow, gives a charming and useful account of members of the medical profession who have attained distinction in other fields of work than those for which they were intended. A few were saints, several were mystics, many were poets, others excelled as writers. Not a few were rascals, and of these a due proportion were caught and hanged. It is noteworthy that until recently the few peerages were bestowed on those who, deserting medicine, had excelled as lawyers. Professor Monro gives a short but sufficient account of each class, and his book will long survive as a work of reference by those who wish to show how a well-trained doctor can turn his hand successfully to many different branches of work. Another edition will certainly be asked for in a short time. A few of the omissions may then be made good. There might be an account of John Smith, who wrote the *Sacred Anatomy, or King Solomon's Portraiture of Old Age*, showing that all anatomy was taught in the first six verses of the twelfth chapter of Ecclesiastes (this is still good reading); of Dr. Marsden, who founded the Royal Free Hospital; of William Kitchen Parker, Wesleyan preacher, general practitioner, and morphologist; of 'Stone henge', who turned from medicine to dogs; and of Augustine Henry, who abandoned medicine, made his name as a botanist in China, and ended as Reader in Forestry at Cambridge and in Dublin.

In some instances Professor Monro is able to attribute honour where honour is due to those whose work was in danger of being forgotten. He shows that Charles Morrison was transmitting messages by electrified wire as early as 1753, and that Henry Faulds published a method of identification by finger-prints in 1880. The book concludes with an account of some eminent American and European doctors who have made their names in other fields of knowledge, and of a few Englishmen who began as medical students but never qualified.

The Technic of Local Anæsthesia. By ARTHUR E. HERTZLER, A.M., M.D., Ph.D., LL.D., F.A.C.S., Professor of Surgery in the University of Kansas, etc. Fifth edition. Large 8vo. Pp. 292, with 148 illustrations. 1933. London: Henry Kimpton. 25s. net.

THIS very delightful book has now reached its fifth edition, and is dedicated to Edwin Edward Wuttke, M.D., for five years Resident of the Halstead Hospital, "a veteran of two wars—in war or in peace a true soldier always". It begins with an account of drugs used in local anæsthesia, but omits some of the more recent and popular narcotics in use in this country. Chapter II describes the technique of injection; the author does not describe the short Schimmel needle, or the powerful syringe such as we in England prefer; he emphasizes the essential need for sharp and fine needles. In subsequent chapters he describes individual operations in great detail, particularly those concerned with the fifth nerve. His descriptions of paravertebral and splanchnic injection and of sacral blocking and trans-sacral injection are excellent.

Spinal anæsthesia is described in Chapter XIV by Arch. E. Spelman, and is very well done, the photographs illustrating it being clear and most useful. Raymond F. Gard writes of intravenous anæsthesia. He omits any mention of our old friend hedonal, and confines himself to sodium amytal (one of the many barbiturates).

As would be expected, the illustrations are numerous—no fewer than 148 in a book of 290 pages. They are all excellently drawn and one regrets no acknowledgment is made to the artists.

The author in his preface to this edition stresses the fact that the "work differs essentially from other books on local anesthesia in that it recommends the use of minimum amounts of solutions, not because of safety, but because a more accurate technic is possible than when large amounts of liquids are injected haphazardly. It advocates infiltrative anesthesia rather than regional blocking because constriction of vessels is secured thereby which aids in exact anatomic operating."

There is no book on local anæsthesia more clearly written and more beautifully illustrated, and none so charmingly "printed and papered".

Intracranial Tumours Roentgenologically Considered. By LOYAL DAVIS, M.D., Ph.D., F.A.C.S., Professor of Surgery, North-western Medical School. Vol. XIV of *Annals of Roentgenology*, edited by JAMES T. CASE, M.D., Professor of Roentgenology, North-western University. Large post 4to. Pp. 277 + xviii, with 135 illustrations. 1933. New York: Paul B. Hoeber Inc. $10.00.

THIS monograph has been written by a neurological surgeon possessing ample experience of the radiology of his subject; and though it would be possible to point out defects and omissions from a purely radiological point of view, it is clear that the editor of this series has been most fortunate in his choice of an author for the fourteenth volume.

The subject of radiology of intracranial tumours is so closely bound up with the clinical aspects that only a neurological surgeon could have given to this book its essential value, which consists in an admirably clear account of the pathology and anatomy of intracranial tumours, and of the correlation of X-ray appearances with their pathology.

The book is based on the author's material of over 300 personal cases: he follows Cushing's method of classification. He first discusses in detail the direct radiological evidence of tumour and shows how the appearances are produced. In one particular—namely, changes in the sella turcica—he seems to err somewhat on the side of dogmatism in discussing the differentiation of intrasellar from extrasellar tumour, for experience shows that anomalous cases occur in which the generally accepted criteria which he describes may be completely misleading.

Radiologists and surgeons taking up the study of intracranial tumours will find keen satisfaction in the author's chapters dealing with the meningiomas, hypophysial adenomas, acoustic neuromas, cranio-pharyngiomas, gliomas, osteomas, and angiomas; his excellent general summaries of their pathology and leading clinical and X-ray features, with his succinct case histories, will serve to fix these main groups and their regional varieties clearly in the memory. Radiologists in particular need just that groundwork which the author provides; to pore over radiograms without that knowledge is to waste one's time, for in cranial radiography minute significant details are sure to be missed unless one knows just what to look for.

A good account of ventriculography and encephalography is given, and the author, rightly emphasizing their risks, relegates these methods to their proper place in the diagnostic scheme—a caution to be taken to heart by enthusiasts who are tempted to adopt them as a routine procedure. The interpretation of the resulting radiograms is beset with difficulties, which the author has not attempted to solve fully. He contents himself with a well selected series of illustrative cases on straightforward lines. Other clinics must work out their special problems in the light of experience, usually by close personal collaboration between surgeon and X-ray staffs.

A chapter is included on radiation therapy which does not take the subject very far. There is a very complete bibliography to the volume and an adequate index.

The principal criticism that may be offered is that the author seems less interested in the radiological technique than in the surgical side of the subject; his descriptions of technical procedures are often inadequate and sometimes confusing or misleading. The details of publication are fully up to the standard set by previous volumes of these series, and considering the delicate character of the X-ray changes, the radiograms are well chosen, and on the whole they are successful.

There are a few minor errors, e.g., in the text a confusion between dorsum sellæ and tuberculum sellæ; again, on page 41, the writer mentions "a line drawn *backwards* from the external canthus of the eye to the *glabella*". There is also an apparent error in the legends to radiograms on pages 68 and 72; the radiogram described as taken in Towne's position on page 133 is an ordinary lateral, the real Towne's view is given on the following page; *Fig.* 104 has been rotated through a right angle in printing. In spite of these criticisms we welcome the book most heartily and congratulate those concerned in its production.

Die Bruchoperation nach Bassini. By Dr. ATTILIO CATTERINA, O.-O. Professor der chirurgischen Operationslehre an der kgl. Universität in Genua. Large crown fo. Pp. 56, with 16 coloured plates by HORATIUS GAIGHER, Doktor der gesamten Heilkunde. 1933. Berlin and Vienna: Urban and Schwarzenberg. RM. 12.

THIS atlas of plates illustrating the operation of Bassini for the radical cure of inguinal hernia is accompanied by an elaborate commentary. The author was a pupil of Bassini's and venerates the memory of his master. He pays tribute by publishing Italian, German, and French editions (to which an English version will shortly be added) of a work dedicated to the perpetuation in its pristine form of an operation that certainly underlies nearly all, if not all, modern methods of radical cure.

Professor Catterina considers that no variation can better any detail of Bassini's original procedure, and attributes any percentage of recurrence above 2 to departure from true form. One curious thing appears; he says that this operation has been accused of peculiar liability to suppuration. He denies, of course, that when properly performed there is any such liability, and surely the day is long past when a particular 'type' of operation can have any such special susceptibility.

It is open to doubt whether there is as much importance in preserving minute details of the original operation as the author suggests, but it cannot be doubted that the essential part of it—complete and deliberate exposure of the anatomical parts, isolation of the sac up to its commencement, and safe ligation at the extremity of the neck—is of the first importance. It may be said further that meticulous display of the parts to be sutured is necessary if anything approaching 98 per cent of permanent cures is to be obtained. It is not so certain that the method of suture —which after all is only 'closure of the wound'—need follow exactly the lines Bassini laid down.

The author, in his text, discusses all the varieties of hernia and the occasional associations and complications. He finds, as do all those who habitually practise it, that this operation is universally adequate.

The plates are beautifully drawn and will well repay study by all young surgeons. Surely few operations remain in wide favour for fifty years.

Handbuch der Unfallmedizin. By DR. CONSTANTIN KAUFMANN (Zurich). Royal 8vo. Pp. 862+xxviii. 1932. Stuttgart: Ferdinand Enke. Paper covers, RM. 52; bound, RM. 55.

THIS is the first volume of the fifth edition of a book originally published in 1892 under the title *Handbuch der Unfallverletzungen*. It contains a comprehensive survey of injuries of all parts of the body in relation to subsequent disability, and a minute account of the legal and 'compensation' aspects as they apply in Germany, Austria, and Switzerland. Brief suggestions are given on treatment, and these conform for the most part with present-day British practice.

In addition to stating the observations from his own experience of forty years in assessing disabilities arising from accidents, the author quotes many Continental and American authorities. As a source of reference for doctors engaged in this type of work, and for the legal profession, this book is of considerable value.

BOOK NOTICES.

[The Editorial Committee acknowledge with thanks the receipt of the following volumes. A selection will be made from these for review, precedence being given to new books and to those having the greatest interest for our readers.]

Text-book of Pathology. By ROBERT MUIR, M.A., M.D., Sc.D., LL.D., F.R.S., Professor of Pathology, University of Glasgow, etc. Third edition. Demy 8vo. Pp. 957 + viii, with 546 illustrations. 1933. London: Edward Arnold & Co. 35s. net.

Die Embolie. By Dr. SIGURD FREY (Königsberg). Royal 8vo. Pp. 178, with 36 illustrations. 1933. Leipzig: Georg Thieme. RM. 12.

Oral Surgery. By STERLING V. MEAD, D.D.S., M.S., Professor of Oral Surgery and Diseases of the Mouth, and Director of Research, Georgetown University Dental School, etc. Royal 8vo. Pp. 1087, with 403 illustrations. 1933. London: Henry Kimpton. 63s. net.

Operative Surgery: the Abdomen and Rectum. By Dr. MARTIN KIRSCHNER (Tübingen). Authorized translation by I. S. RAVDIN, B.S., M.D., J. William White Professor of Research Surgery, University of Pennsylvania. Super royal 8vo. Pp. 569 + xiv, with 395 illustrations, mostly coloured. 1933. Philadelphia and London: J. B. Lippincott Company. 50s. net.

Fractures. By PAUL B. MAGNUSON, M.D., Associate Professor of Surgery, Northwestern University Medical School, Chicago. Medium 8vo. Pp. 466 + xx, with 317 illustrations. 1933. Philadelphia and London: J. B. Lippincott Company. 25s. net.

Surgical Anatomy. By GRANT MASSIE, M.B., M.S. (Lond.), F.R.C.S. (Eng.), Assistant Surgeon, Guy's Hospital, etc. Second edition. Medium 8vo. Pp. 458 + x, with 147 illustrations, many in colour. 1933. London: J. & A. Churchill. 18s. net.

Die Luft- und Fettembolie. By Dr. Med. SIEGFRIED HOFFHEINZ (Leipzig). Vol. 55 of *Neue Deutsche Chirurgie.* Royal 8vo. Pp. 259 + xii, with 50 illustrations. 1933. Stuttgart: Ferdinand Enke. Paper covers, RM. 29; bound, RM. 31.20.

Manuel de Radiodiagnostic clinique. By R. LEDOUX-LEBARD (Paris). Royal 8vo. In two volumes. Pp. 1075 + xvi, with 1143 illustrations. 1933. Paris: Masson et Cie. Fr. 260.

Frakturen und Luxationen: ein Leitfaden für den Studenten und den praktischen Arzt. By Prof. Dr. GEORG MAGNUS, Leitender Arzt der chirurgischen Abteilung des Krankenhauses bergmannsheil in Bochum. Second edition. Large 8vo. Pp. 86, with 43 illustrations. 1933. Berlin: Julius Springer. RM. 3.60.

Human Embryology and Morphology. By Sir ARTHUR KEITH, M.D., F.R.S., LL.D., D.Sc., F.R.C.S., Master of the Buckston Browne Research Farm. Fifth edition. Medium 8vo. Pp. 558 + viii, with 535 illustrations. 1933. London: Edward Arnold & Co. 32s. 6d. net.

An Introduction to the Study of the Nervous System. By E. E. HEWER, D.Sc. (Lond.), Reader in Histology in the University of London, etc., and G. M. SANDES, M.B., B.S. (Lond.), F.R.C.S., Surgeon, London Lock Hospital for Women and Children, etc. Second edition. Large 8vo. Pp. 147 + xiv, with 65 illustrations. 1933. London: William Heinemann (Medical Books) Ltd. 21s. net.

Allgemeine und spezielle chirurgische Operationslehre. By Dr. MARTIN KIRSCHNER (Tübingen). Vol. V/1. Die operative Beseitigung der Bauchbrüche (M. KIRSCHNER). Die Eingriffe an den weiblichen Geschlechtsorganen (G. A. WAGNER). Royal 8vo. Pp. 395 + x, with 304 illustrations. 1933. Berlin: Julius Springer. Paper covers, RM. 78; bound, RM. 86.

Urinary Infections. By CLIFFORD MONSON, O.B.E., F.R.C.S., Surgeon to St. Peter's Hospital for Urinary Diseases, etc. F'cap 8vo. Pp. 76. 1933. London: John Bale, Sons & Danielsson, Ltd. 2s. 6d. net.

A Practical Medical Dictionary. By THOMAS LATHROP STEDMAN, A.M., M.D. Twelfth edition. Royal 8vo. Pp. 1256 + xii. Illustrated. 1933. London: Baillière, Tindall & Cox. 35s. net.